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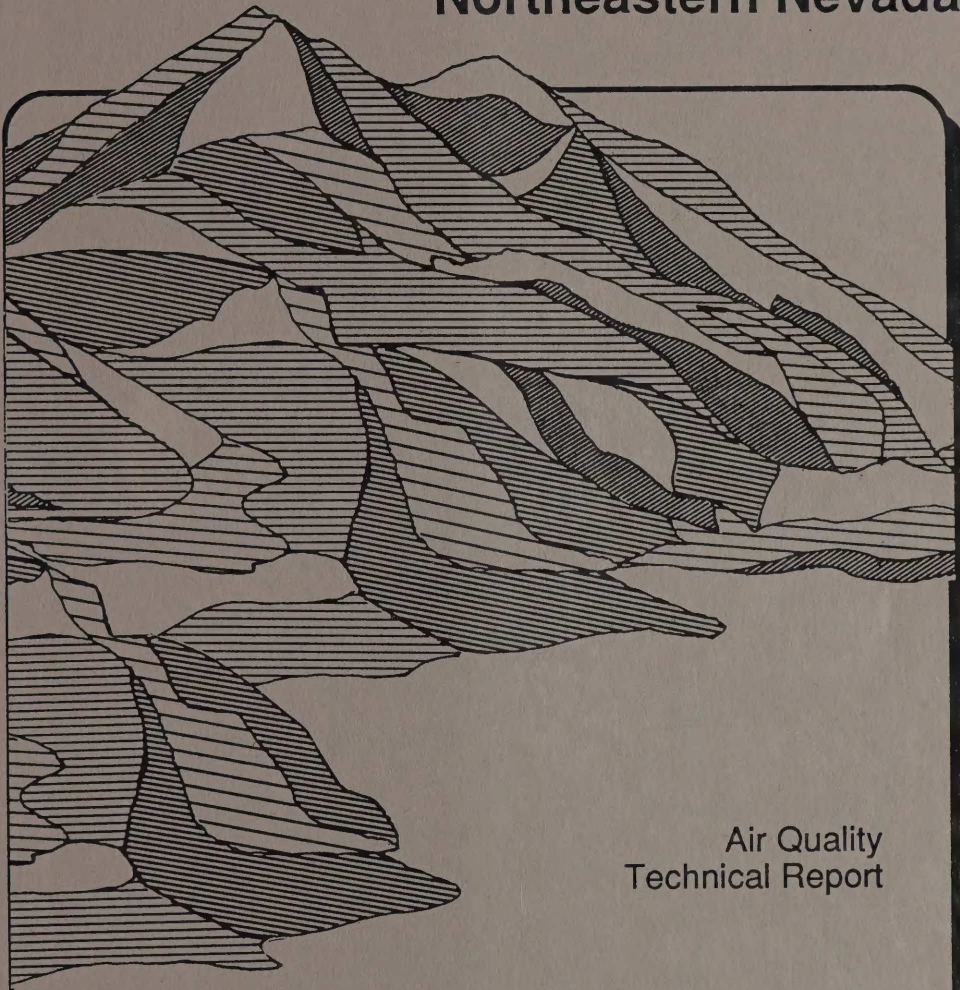
Draft Environmental Impact Statement
Thousand Springs Power Plant
Northeastern Nevada



Air Quality Technical Report

U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Elko, Nevada

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Technical Report

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Air Quality
Environmental Impact Statement
Thousand Springs Power Plant
Northeastern Nevada

U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Elko, Nevada

90266B

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1.0
INTRODUCTION

This document is the Air Quality Technical Report prepared as supporting documentation for the Environmental Impact Statement (EIS) for a proposed coal-fired power plant which the Thousand Springs Generating Company (TSGC) plans to construct and operate in Elko County, Nevada (Figure 1-1). TSGC is a consortium of investors. Sierra Pacific Resources is a member of the consortium and acts as project manager for the consortium. The proposed project involves a land exchange with the Bureau of Land Management (BLM) as well as construction and operation of the power plant and is called the Thousand Springs Power Plant (TSPP) project.

1.1 DESCRIPTION OF THE POWER PLANT

1.1.1 Design of the Power Plant

The TSPP electric generation complex, upon completion, would consist of eight 250-megawatt (MW) (nominal net) coal-fired, steam-electric generating units, designed for baseload duty but with load cycling capability. A plot plan of the proposed facility is provided as Figure 1-2. All components would be designed and constructed in accordance with Federal and state laws, regulations, and policies. Figure 1-3 shows the proposed power plant and the associated ancillary facilities.

Major components of each power generation unit would be as follows: steam generator (boiler); turbine-generator; air emissions control system (dry scrubber and baghouse); stack; circulating water (cooling water) system; water supply, storage, and treatment facilities; waste management and disposal facilities; fuel receiving, storage, and handling facilities; plant control systems; fire protection systems; emergency power; and construction-worker accommodations. Ancillary facilities for the plant as a whole would include access road(s), parking areas, railroad spur, switchyard, offices, warehouses, maintenance facilities, and temporary construction facilities. An 8-foot-high chain-link security fence would be provided around the main plant area. Gates would be provided at all access roads and railroad entrances.

1.1.1.1 Boiler. The boiler (steam generator) for each unit would be a drum-type, natural-circulation, balanced-draft furnace capable of producing high volumes of steam. The boiler would be supplied with heated feedwater, and its steam output would be fed to the turbine generator.

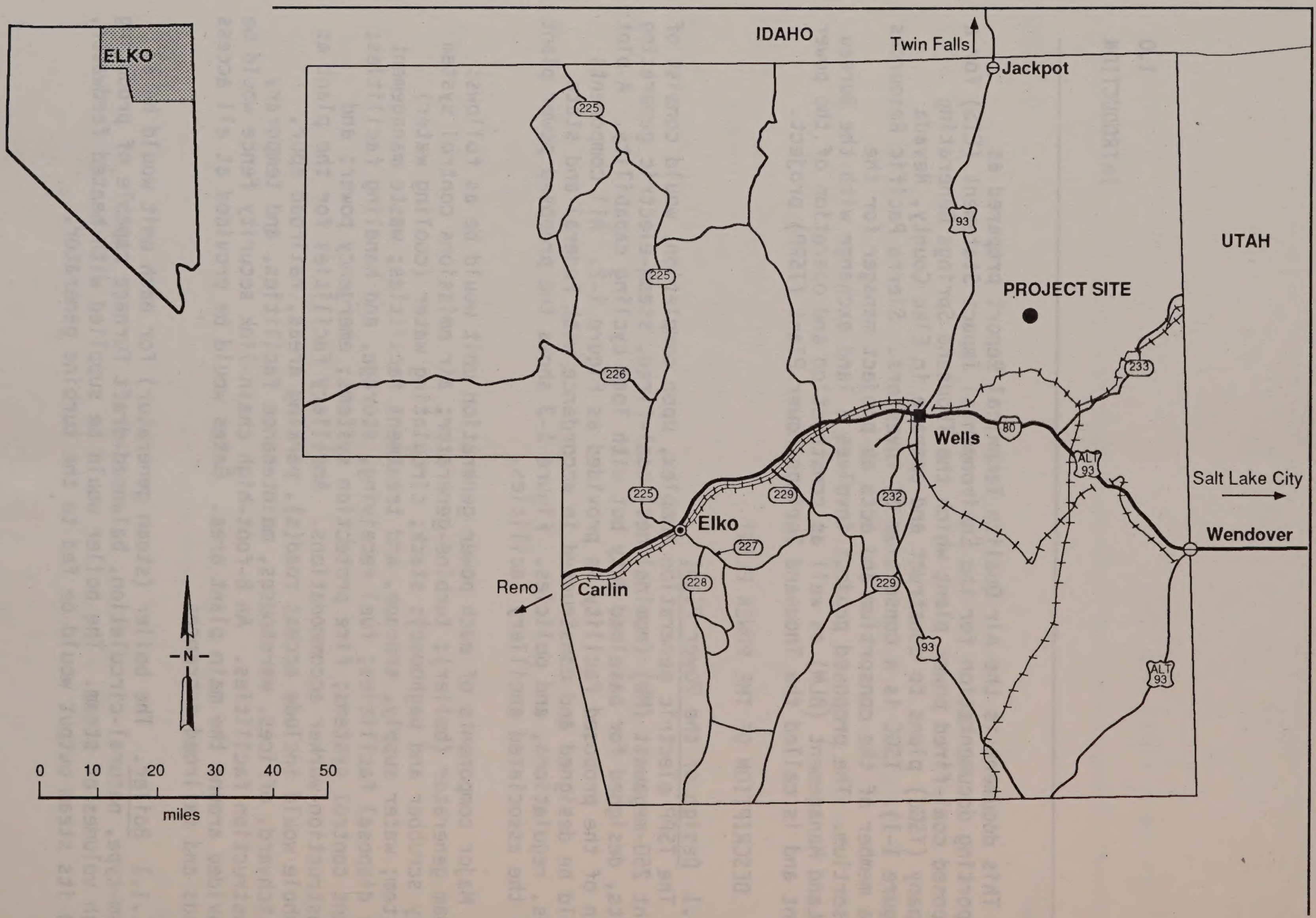
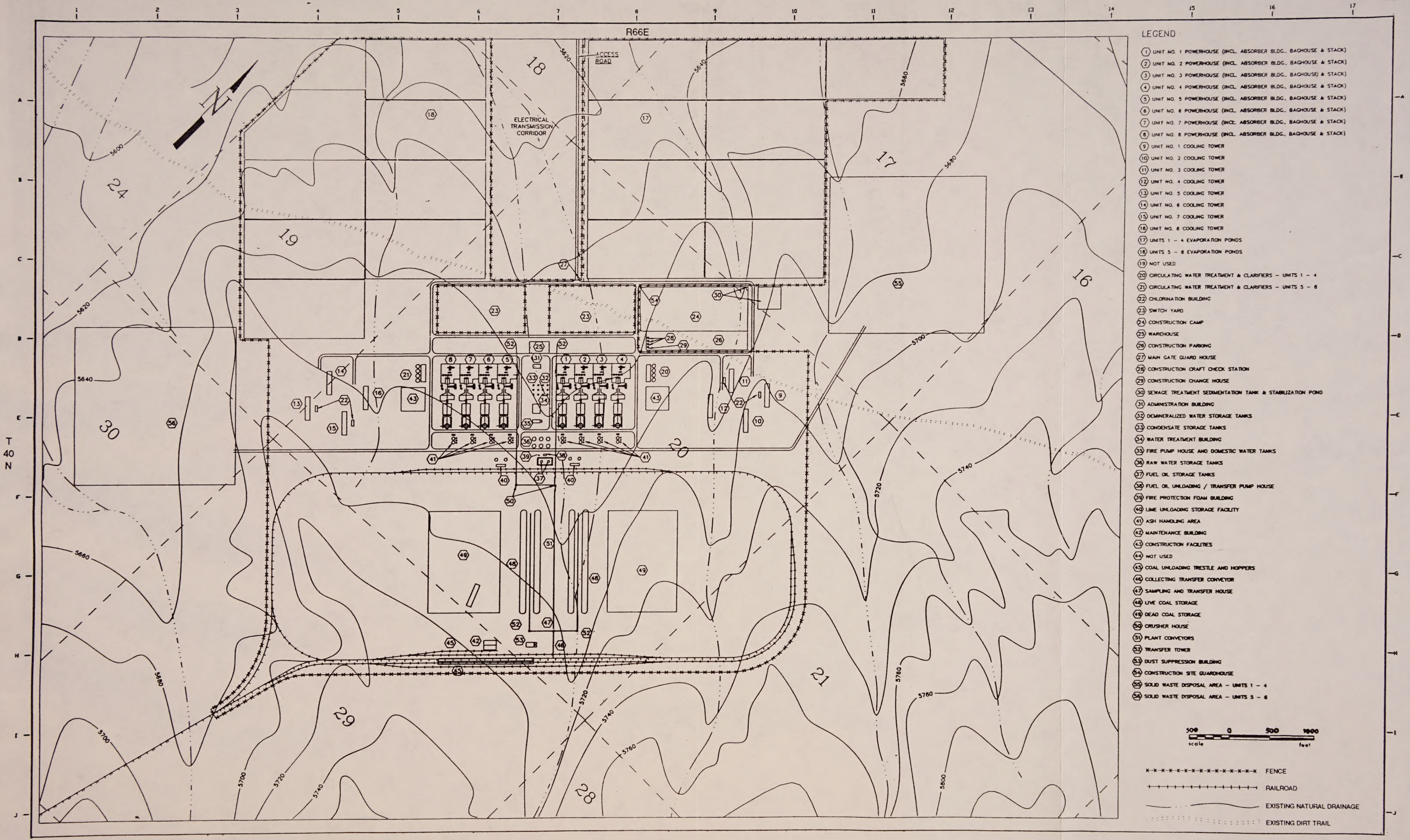


Figure 1-1. PROJECT LOCATION MAP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T 40 N
ACCESS ROAD
ELECTRICAL TRANSMISSION CORRIDOR
18
17
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5600
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5740
5760
5780
5800
LEGEND
① UNIT NO. 1 POWERHOUSE (INCL. ABSORBER BLDG., BAGHOUSE & STACK)
② UNIT NO. 2 POWERHOUSE (INCL. ABSORBER BLDG., BAGHOUSE & STACK)
③ UNIT NO. 3 POWERHOUSE (INCL. ABSORBER BLDG., BAGHOUSE & STACK)
④ UNIT NO. 4 POWERHOUSE (INCL. ABSORBER BLDG., BAGHOUSE & STACK)
⑤ UNIT NO. 5 POWERHOUSE (INCL. ABSORBER BLDG., BAGHOUSE & STACK)
⑥ UNIT NO. 6 POWERHOUSE (INCL. ABSORBER BLDG., BAGHOUSE & STACK)
⑦ UNIT NO. 7 POWERHOUSE (INCL. ABSORBER BLDG., BAGHOUSE & STACK)
⑧ UNIT NO. 8 POWERHOUSE (INCL. ABSORBER BLDG., BAGHOUSE & STACK)
⑨ UNIT NO. 1 COOLING TOWER
⑩ UNIT NO. 2 COOLING TOWER
⑪ UNIT NO. 3 COOLING TOWER
⑫ UNIT NO. 4 COOLING TOWER
⑬ UNIT NO. 5 COOLING TOWER
⑭ UNIT NO. 6 COOLING TOWER
⑮ UNIT NO. 7 COOLING TOWER
⑯ UNIT NO. 8 COOLING TOWER
⑰ UNITS 1 - 4 EVAPORATION PONDS
⑱ UNITS 5 - 8 EVAPORATION PONDS
⑲ NOT USED
⑳ CIRCULATING WATER TREATMENT & CLARIFIERS - UNITS 1 - 4
㉑ CIRCULATING WATER TREATMENT & CLARIFIERS - UNITS 5 - 8
㉒ CHLORINATION BUILDING
㉓ SWITCH YARD
㉔ CONSTRUCTION CAMP
㉕ WAREHOUSE
㉖ CONSTRUCTION PARKING
㉗ MAIN GATE GUARD HOUSE
㉘ CONSTRUCTION CRAFT CHECK STATION
㉙ CONSTRUCTION CHANGE HOUSE
㉚ SEWAGE TREATMENT SEDIMENTATION TANK & STABILIZATION POND
㉛ ADMINISTRATION BUILDING
㉜ DEMINERALIZED WATER STORAGE TANKS
㉝ CONDENSATE STORAGE TANKS
㉞ WATER TREATMENT BUILDING
㉟ FIRE PUMP HOUSE AND DOMESTIC WATER TANKS
㊱ RAW WATER STORAGE TANKS
㊲ FUEL OIL STORAGE TANKS
㊳ FUEL OIL UNLOADING / TRANSFER PUMP HOUSE
㊴ FIRE PROTECTION FOAM BUILDING
㊵ LIME UNLOADING STORAGE FACILITY
㊶ ASH HANDLING AREA
㊷ MAINTENANCE BUILDING
㊸ CONSTRUCTION FACILITIES
㊹ NOT USED
㊺ COAL UNLOADING TRESTLE AND HOPPERS
㊻ COLLECTING TRANSFER CONVEYOR
㊼ SAMPLING AND TRANSFER HOUSE
㊽ LIVE COAL STORAGE
㊾ DEAD COAL STORAGE
㊿ CRUSHER HOUSE
(51) PLANT CONVEYORS
(52) TRANSFER TOWER
(53) DUST SUPPRESSION BUILDING
(54) CONSTRUCTION SITE GUARDHOUSE
(55) SOLID WASTE DISPOSAL AREA - UNITS 1 - 4
(56) SOLID WASTE DISPOSAL AREA - UNITS 5 - 8
500 0 500 1000
scale feet
FENCE
RAILROAD
EXISTING NATURAL DRAINAGE
EXISTING DIRT TRAIL

Source: United Engineer and Constructors, Stearns-Rogers Division, 1989

Figure 1-2. FACILITY PLOT PLAN

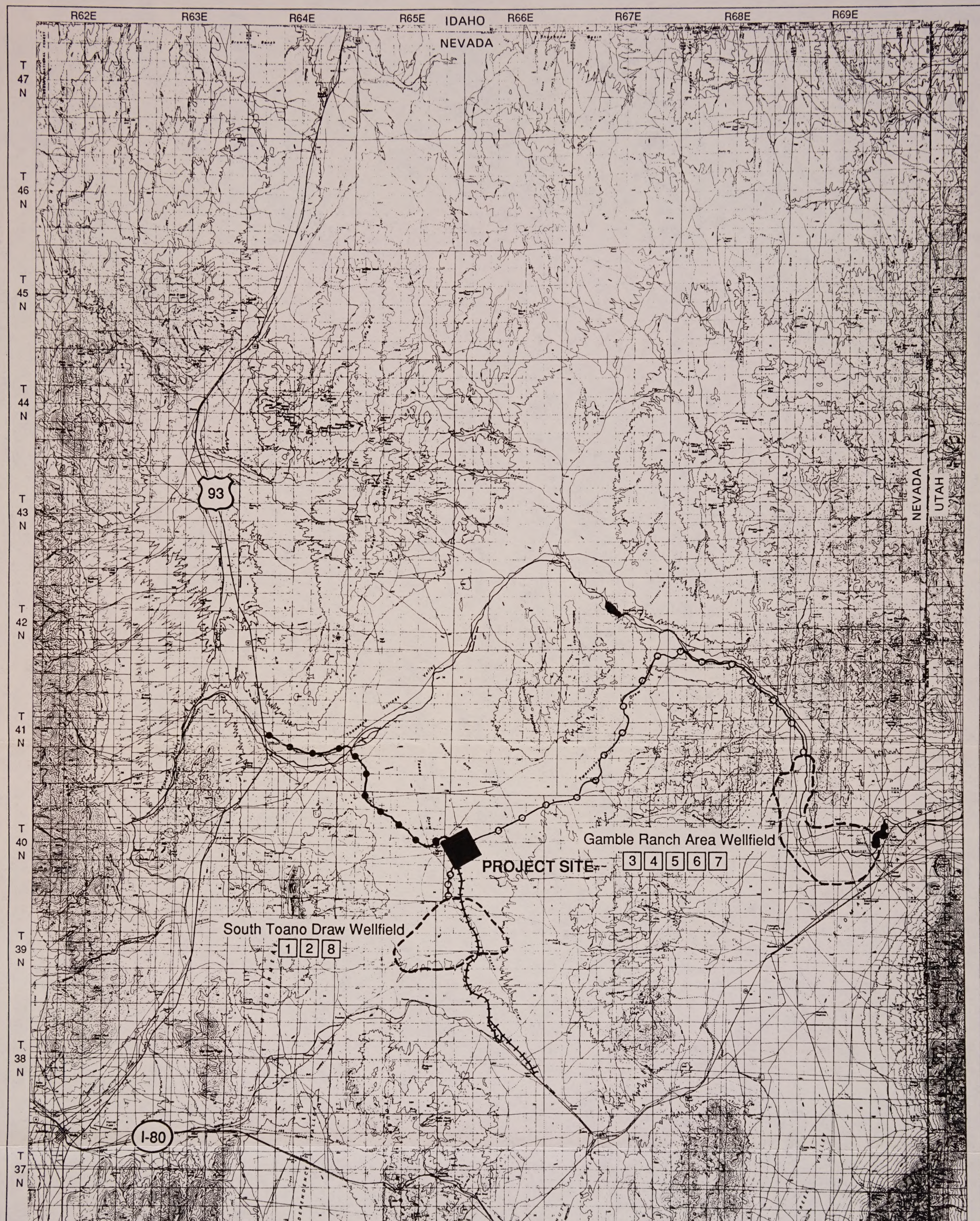

Figure 1-3. LOCATION OF PROPOSED POWER PLANT AND ANCILLARY FEATURES

1.1.1.2 Turbine Generator. The turbine generator for each unit would be a tandem-compound, single-reheat, two-flow condensing type. It would have a guaranteed nameplate rating of 267,521 kilowatts (kW).

The generator would be a direct-connected, hydrogen-cooled unit, rated at approximately 330,000 kilovolt-amps (kva) at 22,000 volts. On-site tank storage of hydrogen would be provided, with sufficient capacity to fill the generator. Carbon dioxide would be provided to purge the generator (prior to maintenance) and would be stored on site.

The turbine would consist of high-pressure and intermediate-pressure units arranged in tandem and a parallel (compound) two-flow, low-pressure unit. Steam would be extracted at various points along the flow path through the turbines, where the temperature and pressure of the steam is appropriate to supply feedwater heaters, the boiler feed pump turbine drive, and auxiliary steam header.

1.1.1.3 Air Emissions Control System. The air emissions control system for each unit would consist of best available control technology (BACT). For the first unit, the proposed BACT unit would consist of three components: a lime spray dryer scrubber system, low-NO_x burners, and a baghouse. The total system would be designed such that sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulate matter (PM) emissions would be at or below existing state and Federal regulatory requirements. The BACT for each unit of the subsequent power generation units would be reevaluated as each unit is developed.

The SO_2 control system would be a lime-based, spray dryer type, scrubbing system. Flue gas exiting the boiler air preheater would be ducted to three spray dryer vessels. Sufficient scrubber capacity would be provided such that one spray dryer could be taken out of service for maintenance while continuing to meet the required stack emission levels with the two other units. The scrubbing medium would be a mixed slurry of slaked lime (calcium hydroxide), and recycle ash (ash recycled from the baghouse ash removal system). The high calcium lime for scrubbing would be received at the plant as 3/4 pebble lime (minus 3 inch) and slaked to a 90 percent, minus 200 mesh slurry. In addition to the spray dryer vessels, the scrubbing system would include steel, quick lime (calcium oxide) storage bins, steel recycle ash day storage bins, lime and ash feeders, lime slakers, mixing tanks, pumps, piping, controls, and auxiliary equipment. The scrubber system equipment would be contained in a building with the spray dryer vessels.

The baghouse would be installed downstream of the scrubbing system and upstream of the induced draft fans and stack. It would be designed to remove the fly ash and scrubber byproducts entrained in the flue gas leaving the scrubber, such that the emissions would not exceed 0.005 grains per actual cubic foot. This requirement ensures that the PM emissions would not exceed the applicable regulatory requirements.

1.1.1.4 Stack. Each unit would be provided with an approximately 450-foot-high single flue, reinforced-concrete stack. The stack would include an 18-foot-diameter corrosion resistant fiberglass liner. At an exit gas temperature of 140°F, it is estimated that the exit gas velocity from the stack at full load would be 3600 feet/minute (60 feet/second). A stack gas emissions monitoring system and computerized Environmental Protection Agency (EPA) emissions reporting system would be provided. Emissions of SO_2, NO_x, and oxygen, and the opacity of the gas stream, would be continuously monitored and recorded.

The stack design would include sampling platforms to accommodate manual and automatic sampling equipment. The location and size of the platforms would conform to appropriate standards of the EPA and the Occupational Safety and Health Administration (OSHA). Stack aircraft-warning strobe lights would be included in compliance with applicable Federal Aviation Administration regulations.

1.1.1.5 Cooling Water System. The cooling water system for each generating unit would include a condenser and a cooling tower, through which the waste heat (i.e., nonrecoverable energy in the spent steam) from the turbine steam cycle would be released to the atmosphere. The condenser and cooling tower would be connected by a circulating water system to form a closed loop cooling system. The low pressure element of each turbine would exhaust spent steam directly into a condenser. The resulting liquid condensate would be collected in the condenser hot well.

Each cooling tower would be a multi-cell, mechanical draft system. Reinforced concrete would be used for the cooling tower basin, which would act as a foundation support and a water catch basin for the tower. At design full load conditions (valves wide open, 5 percent steam overpressure at the turbine), the temperature of the circulating water entering the cooling tower would be about 20.4°F above the wet-bulb temperature. The design wet bulb temperature of 59°F would be equaled or exceeded not more than 1 percent of the time on an annual basis. The water temperature change within the cooling tower (differential temperature between water entering and leaving the tower) would be about 24°F.

1.1.1.6 Waste Management and Disposal Facilities. Surface runoff water from off-site, upgradient areas would be diverted around all station facilities and returned to the natural drainage channels north and west of the plant site. Surface runoff from the power plant site itself would be directed to the natural drainage channels, except those runoff waters which could be contaminated. Potentially contaminated runoff would be directed to and disposed of in the wastewater evaporation ponds on site. Runoff from the coal storage area would be directed to the evaporation ponds.

Floor drainage from the plant could contain small amounts of undesirable materials such as oil, coal, chemicals, and dust. This water would be collected and run by gravity, first to an oil/water separator and then to the evaporation ponds.

Evaporative Waste Ponds. Evaporative waste ponds, approximately 10 feet in depth, would be provided for storage and disposal of liquid wastes for the life of the plant. For Unit 1, a pond of approximately 30 acres would be constructed. Each newly constructed generating unit would have an additional 20-acre pond. The ponds would receive all nonreusable liquid waste such as coal pile runoff, cooling tower blowdown, ash system blowdown, sanitary waste, and wastewaters from chemical cleaning, intermittent boiler cleaning, and equipment washdown. The major chemical constituent in these ponds would be sodium sulfate. Consideration of seasonal variation in the evaporation rate would be included in the final determination of the pond size.

An 8-foot-high chain-link fence would be installed around the evaporation ponds to prevent entry by unauthorized personnel. Cautionary signs would be attached to the fence to warn all persons of the contents of the pond.

1.1.1.7 Solid Waste Disposal. Nonputrescible solid wastes generated during plant construction and operation would be disposed of in a landfill located within close proximity to the plant on private land. As the fill progressed, the compacted waste would be covered with soil material and revegetated. After the plant had been constructed, the only materials to be landfilled, other than mill rejects, ash, and SO_2 scrubber waste, would be small amounts of debris generated by plant remodeling and maintenance activities.

1.1.1.8 Fuel Receiving, Storage, and Handling System. The coal handling system at the station would include facilities for receiving and unloading of unit trains, coal conveying, storage, reclaim, blending, and conveying to the steam generating units. Plant equipment would include coal crushers and pulverizers.

1.1.1.9 Construction-Worker Accommodations. On-site housing would be provided for the construction workers. Quarters would be provided for approximately 220 construction personnel. The quarters would be composed of portable or fixed buildings and could house two workers to a room with a bathroom. There would be a staffed kitchen, mess hall, laundry room, and recreation hall.

In addition, a recreational vehicle park would be constructed to accommodate approximately 300 vehicles. This park would consist of parking spaces, electrical, water, and sewer hook-ups, shower/toilet facilities, and a laundry building.

The worker housing and the recreational vehicle park combined would accommodate 520 construction workers (or more if two or more workers shared a recreational vehicle).

1.1.1.10 Access Road. The proposed plant access road would run from U.S. Highway 93 near Wilkins, east for approximately 4 miles along an existing county road, and then southeast to the project site. The county road would be upgraded, and approximately 10 miles of new road would be constructed from the county road southeast to the plant site at a maximum width of 100 feet. A stream-crossing culvert would be used to cross the main channel of Thousand Springs Creek. An earthen embankment would carry the road across the remainder of the floodplain. Smaller pipe culverts would be used, as required, for crossing other minor drainage channels. A high-load, bituminous paving would be used for the wearing surface of the two-lane road from Wilkins to the plant site. The access road to the plant would be fenced with a BLM-specified wire fence to prevent domestic livestock from encroaching on the road but allow wildlife to cross. The road around the main plant area would be bituminous paved in the vicinity of the first unit, and would be extended as additional units were built. All other roads would have a gravel-wearing surface. A paved parking area would be provided near the administration offices. Gravel maintenance roads would be used to service the evaporative wastewater pond and cooling towers. Gravel, for use in construction and maintenance of the roads, would be purchased from existing gravel suppliers, and would not involve any additional public land.

1.1.1.11 Railroad. The Southern Pacific Railroad has a two-track line from east of the plant site that passes through Montello and Cobre to Wells. A railroad spur, to transport coal to the facility from coal mines in Kemmerer, Wyoming, and Scofield, Utah, would be constructed off the Southern Pacific Railroad track. It would begin approximately 3 miles northwest of Cobre, at Valley Pass, and would run northwest approximately 14 miles to the plant site with a maximum width of 200 feet. The railroad spur would be constructed with two short tracks from Southern Pacific Railroad's dual track, to allow ingress and egress to and from the plant site. The spur, unloading loop, and switchyard would be designed and constructed in conformance with railroad standards. The railroad spur to the plant site would be wire-fenced, using BLM specifications. The unloading loop would be designed so that two unit trains could unload coal simultaneously (one 55-car unit train would carry approximately 6600 tons of coal), although initial construction would provide for unloading only one train at a time. The loop would be expanded to serve two trains in conjunction with construction of the fifth unit.

1.1.2 Construction of the Power Plant

1.1.2.1 Construction Activities. The proposed power plant, upon completion of development, would consist of eight 250-MW, coal-fired, steam-electric generating units. Construction of the first unit is described here in terms of the following seven overlapping phases:

1. Access road construction and site preparation
2. Construction of internal access and utility network
3. Construction of plant facilities (housing, shops, fire pumphouse, etc.)

4. Concrete foundation installation
5. Structural steel erection
6. Major equipment and main building erection
7. Piping, electrical connection, and instrumentation installation

Construction of the first unit is scheduled to commence in early 1991 and be completed in late 1994. Commercial operation of this unit is anticipated in the second quarter of 1994.

Phase 1 activities would involve clearing, grading, and surfacing approximately 14 miles of heavy load type asphalt access road, clearing and grading of approximately 14.5 miles of railroad bed, and site preparation for construction facilities. The access road would require a 100-foot-wide construction right-of-way and the railroad spur would require a 200-foot-wide construction right-of-way to accommodate the equipment during construction and for the storage of materials. A disturbance of approximately 380 acres would occur during construction.

Phase 2 would involve excavation, installation, and backfilling of underground facilities for water lines, sewers, drains, and electric ducts. Roads serving construction offices, warehouses, storage areas, fire pump house, etc., would be developed at this time.

Phase 3 would start the building of both temporary and permanent plant facilities. Temporary facilities include construction-worker housing, the RV park, construction management personnel and contractors office area, warehouses, a materials storage area, and unprotected material storage sites. Permanent facilities include a fire pumphouse, wells, a potable water treatment building, power lines, an electric substation, and a telephone system.

The majority of the concrete work would begin during Phase 4. Pits would be excavated for the spread footings and concrete would be poured into forms. Trenches would be dug for the grade beams, and concrete would be poured. Slabs would be poured into forms, with reinforcing steel, on compacted ground surfaces.

Phase 5 would involve erecting the main steel framing that would support the boiler and all major equipment. It would also involve constructing the rail spur, coal receiving, and unloading siding.

In Phase 6, large-diameter piping would be hoisted into its approximate location for later installation and electric cable support trays would be erected. The boiler and turbine generator erection would begin.

Phase 7 would involve connecting the various ducts, pipes, communications conducts, conveyors, and other equipment required to operate and control the fuel, air, steam, water, waste product, and electric systems that comprise a coal-fired, steam-electric generating facility. Piping for the transporting of water, steam, chemicals, and waste products would be routed to the respective areas using both welding techniques or mechanical bolting. Electric cables for operating motors, lights, switches, and controls would be connected throughout the plant. Instruments needed to control and monitor all the processes would be installed and connected to display panels and recorders in the control room.

Construction of additional generating units would require about 34 months each and would overlap with the preceding unit by 10 months. This would allow for an efficient transition of resources from unit to unit. As site preparation, excavating, backfilling, and concrete activities would be completed on one unit, they would start on the next. Some of the other activities such as structural steel, electrical, and piping erection would involve short breaks between units due to their shorter construction duration. However, a small portion of all the crafts involved would be needed almost continuously throughout the entire project construction period for final touchup and warranty work.

The timing for implementation of each phased unit would be dictated by market demand for electrical power. The first peak of construction workers is anticipated to be 805 workers in 1993, associated with construction of Units 1 and 2. The average workforce during that year is anticipated to be approximately 500. A second workforce peak is anticipated between the completion of the fourth and fifth units in 2000 due to the addition of duplicate major facilities such as:

- Coal unloading, handling, and storage
- Fire protection, pump house, tanks, and water mains
- Plant electrical substation and associated equipment

Site clearing, grading, and surfacing would be confined to those areas to be built upon, utilized during construction, or which are part of the ash disposal area. Site clearing would be conducted on an "as-required basis," and individual areas would be cleared just prior to construction startup. Vegetation that required removal would be disposed of on site in a Class III disposal site.

Grading requirements for the site are minimal, owing to the relative flatness of the existing terrain. The immediate powerhouse area would be graded to a uniform level and sloped away from the plant in all directions. The coal storage area would be graded to a uniform level and sloped towards the evaporation ponds to provide drainage and control of runoff containing fine coal particles. Other disturbed areas would be graded to preserve natural drainage patterns and to prevent erosion. In total, approximately 1240 acres of land would be disturbed at the power plant site upon completion of development. Including the railroad spur, access road, and water pipeline, a total of approximately 1780 acres would be disturbed upon completion of development. Table 1-1 summarizes the acres disturbed or covered by project components on a unit-by-unit basis.

Table 1-1. APPROXIMATE AREAS OF DISTURBANCE BY CONSTRUCTION ACTIVITIES PER 250-MW UNIT (ACRES)

POWER GENERATION UNITS:	1	2	3	4	5	6	7	8	Total
PLANT SITE									
Units 1-8 and Main Plant	20	15	15	15	15	15	15	15	125
Railroad Loop	60								60
Construction-Worker Camp	18								18
Switchyard 4	4	4	4	4	4	4	4	32	
On-site Roads	14	3	3	3	3	3	3	3	35
Cooling Towers	7	6	6	6	7	6	6	6	50
Major Drainage Structure	5								5
Solid Waste Disposal	67	67	67	67	67	67	67	67	535
Sewage Lagoon	5								5
Evaporation Ponds	30	20	20	20	20	20	20	20	170
Construction Laydown Area	30	10	10	10	10	10	10	10	100
Coal Runoff Pond	12				13				25
Coal Piles (dead storage)	10	10	10	10	10	10	10	10	80
Subtotal								1240	
ANCILLARY FACILITIES									
Proposed Access Road (100' width)[a]	120								120
Railroad (200' width)[a]	260		155						260
Water Pipeline (50' width)[a]	5		160						160
Subtotal								540	
TOTAL	467	135	290	135	149	135	135	135	1780

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[a] Actual area disturbed during construction would be less. The area permanently covered by ancillary facilities would be less than that disturbed during construction.

1.1.3 Operation of the Power Plant

The proposed action for the power plant operation involves a baseload power plant, operating 24 hours a day, 365 days per year. The plant would operate using three 8-hour workshifts. The operational workforce would be approximately 145 persons for each pair of units or 564 operation workers upon buildout of all eight units.

1.1.3.1 Fuel Receiving, Storage, and Handling. The power plant would burn low-sulfur coal. Coal would be delivered to the plant site by unit trains. The coal would be produced from mines at Kemmerer, Wyoming, and Scofield, Utah. Each mine would supply coal in an amount equal to 50 percent of the heat input to the generating units.

Studies conducted by the John T. Boyd Company determined that these two mines can supply the required coal without increasing the size of the mines or the scale of the mining activities that are in their respective approved mining plans and their business plans.

Coal would be delivered along a new rail spur, approximately 14 miles long, between the Southern Pacific Transportation Company's main line at Valley Pass and the plant site. The new spur would be constructed and maintained by TSGC.

All eight generating units would be served by two coal receiving, storage, and handling systems. Each system would independently serve four generating units, and would be designed using identical equipment. Coal would be received from the mine(s) in unit trains that would operate continuously between the mines and the plant. Generally, coal would be received in lumps not larger than approximately 2½ inches maximum dimension; however, frozen masses up to 15 inches across could be expected.

At full load conditions, using coals complying with the performance specifications, and operating at a capacity factor of 100 percent, each generating unit would consume approximately 1380 tons per day of coal from the Scofield, Utah, mine and approximately 1620 tons per day of coal from the Kemmerer, Wyoming, mine, for a total of approximately 3000 tons per day per unit. The demand would be somewhat lower based upon the average annual load factor (i.e., 85 percent) of each unit. Average total annual coal consumption thus would be about 926,700 tons per unit. To support this average firing rate, each unit would require one 55-car unit train to be delivered every 5 days from the Scofield, Utah, mine, and every 4 days from the Kemmerer, Wyoming, mine.

Units 1 and 2. Coal from the unit train would be dumped into a compartmentalized undertrack bunker below the unloading trestle while the train is in motion (up to 5 mph). Unloading would require about 20 minutes for a 55-car train. The bunker would have the capacity to hold up to 100 cars (104 tons each) of each of the two coals. This is equivalent to 7 days of live storage for one unit at full capacity. Two rotary plow feeders would transfer the coal from the bunker to one 3200-ton-per-hour (tph) trestle reclaim conveyor. The reclaim rate is variable, from 0 up to 1600 tph of each coal. For the first two units, the reclaim rate would be 900 tph total. The rotary plows would allow blending the coal at this point, if a bunker of each coal is available. A magnetic separator would be mounted at the discharge end of the conveyor to remove ferrous material from the coal.

If both coals were not available in the bunkers, blending would be accomplished by reclaiming the appropriate coal from the dead storage area at the required rate. A variable-rate feeder below the reclaim hopper and a belt scale on the reclaim conveyor would allow the required flow rate to be maintained, within the operating limits of the reclaiming equipment.

Once the coal had been blended and transferred, the trestle reclaim conveyor would discharge to the unloading transfer conveyor, which would discharge to either the yard conveyor or the dead storage transfer conveyor. The yard conveyor would, in the future, discharge to either a silo feed conveyor or a crusher transfer conveyor. For Unit 1, however, the silos would not be in place, and all coal would be discharged to the crusher transfer conveyor and be taken directly to the crusher facility.

A vibrating screen is proposed to be used to bypass all the coal smaller than 3/4 inches around the crusher. This would allow the use of a smaller crusher, but would require a large screen to handle the 900-tph flowrate. The physical size of the screen(s) may make screening impractical. Assuming screening is done, both the bypassed and crushed coal ultimately would be transferred to the plant boiler silos via the plant conveyor and the plant silo tripper conveyor. Should screening and bypassing prove to be impractical, all the coal would pass through the crusher and then to the plant boiler silos as just described. The one (or two) coal crusher(s) would reduce 90 percent of the coal to a size less than 3/4 inch. The "as fired" coal would be sampled at the discharge of the plant conveyor, immediately upstream of the plant boiler silo tripper conveyor prior to delivery to the boiler sites. The plant boiler silos would have a total of 2000 tons capacity per unit, allowing 16 hours of storage for one unit operating at full load.

No conveying system redundancy would be provided for Units 1 and 2. All conveyors would be sized to transport the required full load tonnage of coal to the plant in 4 hours (or less) per shift, three shifts per day. Thus at least one-half of each shift would be available for maintenance of the fuel handling system, and 12 to 16 hours in one block of time would be available, without restricting output capacity, if the plant silos had been "topped off" each shift.

Units 3 and 4. When the third unit is constructed, a redundant conveyor system would be added. In addition, live coal storage silos and the required storage silo feed, reclaim conveyors and equipment would be added. An additional 55- to 85-car unit train would also need to be added for the third and fourth units. The addition of live coal storage silos would eliminate the need to maintain active live coal storage piles. Coal could still be reclaimed from the dead storage piles if needed.

One or two live coal storage silos would be provided for each type coal burned. Each silo would be approximately 70 feet in diameter by 210 feet high, with a capacity of approximately 12,000 tons. This is equivalent to 4 days of live storage for one unit in each live coal storage silo. Additional storage silos may be added for more live storage.

Coal would be reclaimed from the live coal storage silos on a more or less continuous basis. Multiple feeders would reclaim coal from the storage silos to belt conveyors rated at 900 tph each. If emergency reclaim were necessary, coal would be reclaimed from the dead storage area. Reclaim hoppers of reinforced concrete and steel would be located below grade, near the stackout piles in the storage areas. Coal from the yard would be dozed or hauled by scraper to the reclaim hopper. The dead storage reclaim conveyor would be directed to the yard conveyors; thus reclaimed coal could flow either through the silos or directly to the crusher facility.

From the storage silos, coal would be transported by 900-tph belt conveyors to the crusher facility. Coal would then be transported by conveyors, tripper conveyors, and chutes to the plant boiler silos located near the front of each boiler. Two tripper conveyors (900 tph each) would be provided above the boiler silos to allow discharge of the coal to any of the four boiler silos.

All Eight Units. Inactive (dead) coal yard storage would be provided for the station based on 90 days' supply for four units at an average annual load of 85 percent of nominal generation capacity. The dead storage area would provide a reserve from which the station can be supplied during coal shortages or emergency situation, e.g., mine strikes, rail strikes, etc. Coal would be segregated in the yard by mine source. A conveyor would be provided for yard stackout of the delivered coal. From the stackout point, coal would be either dozed or hauled by self-loading scrapers to its desired storage area. Based upon a coal pile height of 30 feet, areas of approximately 13 acres and 15 acres will be allotted for dead storage of the Scofield, Utah, and Kemmerer, Wyoming, coals, respectively. This would provide a 90-day supply for four units.

Two coal sampling systems or continuous on-line analyzers would be provided to allow sampling of coal delivered to, and fired at, the station. Weigh belt feeders would be provided where necessary to determine mass transport.

Dust control would be provided at all of the transfer points in the conveying system. The coal handling system would utilize five forms of dust control: suppression, collection, ventilation, containment, and washdown. Throughout the system these methods would be employed to minimize fugitive dust generated by the handling and processing of the coal.

Dust Suppression. The dust suppression supply pump, tank, and controls would be located in the Sampling and Transfer House. Blowdown from the circulating water system would be used as the water source.

The distribution system would comprise two subsystems: one servicing the Dump Hopper Area and one the Storage Area and the Crusher Building. Each system would be designed with one pump in service (and one spare pump) supplying water automatically to the various areas as called for on a demand basis by the flow controllers mounted near the spray locations.

Dust Collection (Dry). Several bag-type dust collectors would be incorporated into the coal handling systems, one at the Sample and Transfer House, one at the Crushing Building, one at the Transfer Tower, and one at each Unit Coal Silo Area. The dust collectors would be fully automatic and interlocked with the coal handling system.

Ventilation. Ventilation systems would be located at numerous points throughout the coal handling system. At the Dump Hopper Collection Tunnel, the system would supply ventilation for the unloading area. Tunnel ventilation systems would also be located at each dead Storage Reclaim Tunnel. Ventilation would also be provided to the tripper area of each Unit Coal Silo Area.

Containment. Dust migration to the atmosphere would be minimized by containment in various ways. The conveyor galleries would be totally enclosed. All coal transfer equipment, belt feeders, vibrating feeders, and diversion gates would be totally enclosed to reduce coal dust emissions.

Washdown. All walkways, platforms, and other places with horizontal surfaces where fugitive dust might accumulate would be provided with washdown systems.

1.1.3.2 Power Generating System. Each generating unit (system) would include a boiler, turbine generator, lime spray dry scrubber, fabric filter, stack, and mechanical draft cooling tower. For all practical purposes, each unit would include essentially identical components to facilitate equipment interchange.

The estimated normal average load factor for a unit would be 85.8 percent for the first 5 years of operation. The load factor would progressively decrease to an estimated 53.2 percent in the 31st year of operation and thereafter (refer to Table 1-2). The average load factor for each unit over its expected 35 years of operation would be about 75 percent.

Boilers. Coal, conveyed from the coal yard area, would be distributed to and stored in four steel boiler silos included with each boiler. The

Table 1-2. SUMMARY OF UNIT ANNUAL LOAD FACTORS BASED ON VENDOR GUARANTEES

Years	Avg. Load
1-5	85.8
6-10	84.9
11-15	83.4
16-20	79.9
21-25	73.6
26-30	64.5
31-35	53.2

Levelized Annual Operating Factor 75 percent (based on maximum capacity generation)
Operation factors over plant life expressed as percentages of 8760 hours

boiler silos would have 12 hours' total storage capacity. Coal, discharged from each boiler silo, would flow by gravity to a gravimetric-type coal feeder through a stainless-steel cone having a shutoff gate. Each of the feeders would discharge through a stainless-steel pipe to a pressurized coal pulverizer (four per unit). The coal would be pulverized to 70 percent minus 200 mesh sieve size (or 0.074 mm). A large percentage of the iron pyrites present in the coal would be segregated from the coal during grinding and discharged through a reject side stream to the bottom ash handling system.

Two primary air fans per generating unit would supply air for pneumatically conveying coal from the coal pulverizers to the coal burners (fuel nozzles) mounted on the walls of the furnace. Coal would be supplied to several fuel nozzles from each of the four coal pulverizers serving a boiler. The coal conveyance air would constitute a major part of the air required for the combustion process. Secondary air fans would supply the balance of the required combustion air.

The entire combustion process would be designed to ensure that coal combustion would be complete. Excluding flue gas, the principal products of burned coal would be bottom ash, fly ash deposited in the economizer and air preheater hoppers, and fly ash carried through to the scrubber and baghouse.

Oil-fired ignitors would be provided at each burner for initial lighting of the burners and warmup of the furnace. Fuel for the ignitors would be No. 2 fuel oil, supplied by pumps from an on-site oil storage tank. The fuel oil tank would be placed within an earth-diked enclosure capable of retaining at least 110 percent of the maximum stored volume of oil.

Air Emission Control System. Lime, purchased off site and delivered to the plant, would be conveyed to long-term (15-day) storage silos located adjacent to the unloading area. Pneumatic conveyors would transfer lime from the long-term storage silos to the scrubber day bins. A lime requirement of about 50 tons per day would be required for each unit at full load.

Initially, lime would be delivered to the plant by 25- to 30-ton capacity, differential pressure, pneumatic transfer truck trailers. Provisions would be made to allow rail delivery of lime, as the demand for lime increased with the size of the station (i.e., as additional units were placed on line).

Flue gas exiting the boiler air preheater, at approximately 280°F, would enter the top of the spray dryers. At the top of each spray dryer, the flue gas would be evenly distributed and accelerated through scrolled dispersers. At the discharge of the dispersers (inlet to the spray dryer), the flue gas would interface with a finely atomized spray of scrubber slurry. Atomization of the slurry would be accomplished by high speed spray machines, which include centrifugal atomizer discs.

The gas exiting the dispersers would travel down the spray dryer chamber. As a result of the thorough mixing of the flue gas and the lime slurry spray, sulfur dioxide gas in the flue gas would react with calcium hydroxide in the slurry to form calcium sulfite and calcium sulfate. Simultaneously, the sensible heat of the gas would cause the water in the slurry mist to evaporate, leaving a dry PM residue suspended in the treated gas stream. The gas stream would exit through the angled bottom of the spray dryer vessel at approximately 165°F. The scrubber reaction products and fly ash would be transported by the gas stream to the baghouse for PM collection.

At the baghouse, fly ash/scrubber byproduct-laden gas would be drawn into the baghouse inlet manifold duct. PM from the gas stream would be deposited on the interior of the filter bags. Cleaned gas, exiting the filter bags of each compartment, would be drawn into an outlet duct by the induced draft fans and discharged to the atmosphere through the stack.

PM collected on the interior of the filter bags would be periodically dislodged from the bags by the reverse gas cleaning process. The PM would fall into the compartment hopper. Material collected in the hopper would be pneumatically conveyed, by the fly ash handling system to the fly ash storage silo. There it would be mixed with bottom ash, and then trucked to disposal in an on-site landfill.

The bottom ash (i.e., coarse ash collected at the bottom of the furnace) and mill rejects (pyrites) would be sluiced from the plant and dewatered before being mixed with fly ash and trucked to the landfill. Based on the estimated use of coals, at full load each unit would produce about 1.4 tons of bottom ash and pyrites per hour. Over the expected life of the plant, about 2.6 million tons of this material would be produced.

Fly ash and scrubber byproduct would be collected in the baghouses. Fly ash would also fall out in the economizer and air preheater hoppers. This waste would be transported pneumatically to the fly ash silo. At full load each unit, burning the designed coals, would produce about 11 tons/hr of fly ash and scrubber byproduct. Over the expected life of the plant, approximately 20.5 million tons of fly ash and scrubber byproduct would require disposal. The fly ash/scrubber byproduct would be wetted, by mixing with the wet bottom ash, to approximately 15 percent moisture by weight before being trucked to the landfill (to aid in handling, preventing dusting, and improving compaction characteristics). The total landfill disposal acreage required for both bottom ash and fly ash/scrubber waste is estimated to be approximately 535 acres, assuming an average disposal depth of about 20 feet. Surface runoff waters, from areas upgradient of the ash disposal area, would be diverted around and past the disposal area, to protect the integrity of the disposal facility. Final design of the disposal facility would be based on the results of a detailed geotechnical investigation of the disposal area, to be accomplished as part of the design process, and regulatory requirements for the disposal of the materials as would be applicable at the time of design for each generating unit. It is expected that, as a minimum, the disposed material would be capped with a relatively impervious, compacted earth material that would be graded and sloped to facilitate surface runoff but without significant potential for erosion and removal by either wind or water.

The applicant has indicated that if, for any reason, the air emissions control system fails to perform (i.e., upset condition), then the operation of that electric generation unit would be curtailed, as necessary, until such time as the air emissions control system functions normally.

Turbine-Generator. The turbine-generator of each unit would have a nominal gross (nameplate guarantee) rating of 267,521 kW, which would yield a net output of 250,000 kW. The maximum gross generating capability (maximum load) for each unit would be 292,666 kW with the control valves wide open, and steam at 5 percent overpressure (above the nominal design pressure).

The turbine generator would convert the energy in high temperature, high pressure steam (1000°F, 2400 pounds per square inch [psi]) to electrical energy. The electricity would be delivered to the unit main stepup transformer and on to the switchyard for regional distribution.

Steam to drive each turbine generator would be piped from its respective boiler. The low-pressure, low-temperature steam exhausted from the turbine would discharge directly into a condenser. The resulting condensate would be returned to the boiler. Condenser cooling water (circulating water) would be pumped to the top of a mechanical draft cooling tower (one for each unit) where it would be exposed, in the form of falling droplets, to a counter flow of air which would cool it, primarily by evaporation. The cooled water would be recycled to the condenser. Makeup water would be supplied to the cooling tower from the well system after proper treatment.

Condensate Feedwater System. Condensate would be pumped from the condensor hotwell and would be routed to the economizer inlet of the boiler. Feedwater heaters would be provided in this system to increase the temperature of the condensate before it enters the boiler. Steam, extracted from various sections of the turbine, would be piped to the various feedwater heaters.

Cooling Tower. The circulating water would be warmed in its passage through the condenser by heat released due to condensation of the low-temperature, low-pressure steam exhausted from the low-pressure turbine. The heated circulating water would be pumped to the cooling tower via underground circulating water piping. In the cooling tower, the circulating water would be cooled by exposing a large water surface area in the form of small, falling water droplets to a mechanically induced upward flow of air. The water would be cooled by both sensible heat transfer and by evaporation of some of the water. For each generating unit, two half-capacity circulating water pumps, located adjacent to the cooling tower basin, would return the cooled circulating water through underground piping to the condenser. Some of the circulating water would be drawn off to serve other heat exchangers associated with the overall generating unit.

In the cooling tower, approximately 1 pound of water would be evaporated and discharged to the atmosphere for each pound of steam condensed in the condensor. The amount would vary slightly, depending upon the amount of sensible heat absorbed by the air from the water. Evaporation losses would be less in winter than in summer. Additional water losses at the cooling tower (drift) would result from mist entrained in the air stream discharging from the top of the tower. Drift eliminators would limit and control this loss. Generally, about 0.005 percent of the tower flow normally would be lost as drift.

To maintain acceptable levels of dissolved solids and to avoid scaling in the condenser, cooling tower (circulating) water would be drawn off continuously (blowdown) and replaced by fresh water. The blowdown water would be used as a source of water for the scrubber, coal dust suppression, bottom ash transport, and other uses. Fresh water would be added to the circulating water system to compensate for losses due to evaporation, drift, and blowdown.

1.1.3.3 Water Treatment for Circulating Water System. Evaporative water losses in the cooling tower would concentrate the dissolved solids in the remaining water. As these concentrations increase, calcium carbonates and silica in the water could cause scaling on the condenser tubes and decrease the heat transfer efficiency of the condenser and thus decrease the efficiency of the plant. To prevent scaling, the pH level of the water would be adjusted automatically, as required, by the addition of dilute sulfuric acid.

To minimize plant water use, the dissolved minerals in the circulating water probably would be concentrated by a factor of 20 to 30. It is expected that either the makeup water would be treated by the lime soda process or a side stream from the system would be treated by lime softening, or both processes would be utilized to maintain hardness and silica levels below their scale-forming concentrations.

To prevent biological growth and slime buildup that could adversely affect the heat transfer efficiency of the condenser and foul the cooling tower, circulating water would be treated with chlorine, as required. Chlorine for each unit would be stored in 1-ton cylinders in a separate building with alarms, vents, and containment structures.

1.1.3.4 Plant Water Supply. Water, for use in generating steam and for transferring plant-generated waste heat to the atmosphere, would be obtained from wellfields in the Thousand Springs drainage basin. The wellfield to supply two or three generating units would be located in the Toano Draw Subbasin, which is also where the power plant would be located. For the other five or six units, it is expected that one or more wellfields would be developed along the lower reaches of the Thousand Springs Creek in the vicinity of Gamble Ranch. The estimated maximum plant water requirement is 4000 acre-feet/year per generating unit, or 32,000 ac-ft/yr upon completion of plant development.

The conceptual design of the pipeline would be a 33-inch-diameter metal pipe, buried to a depth of 3 feet, and would require a maximum width of 50 feet of disturbance and an approximate length of 26 miles.

Lands of Sierra, Inc. (LOS), a subsidiary of Sierra Pacific Resources, owns extensive lands and most of the water rights that have been granted in Thousand Springs Basin. LOS has contracted with TSGC to supply all water required to construct and operate the TSPP.

1.1.3.5 Boiler Feedwater Treatment. The boiler feedwater makeup treatment system would receive raw water directly from the well system. The effluent from the boiler makeup treatment process would be used to replace the losses in the steam cycle and boiler blowdown. The treatment process would depend upon the quality of wellwater available. It is anticipated that this process would include lime softening, filtration, reverse osmosis, and ion exchange demineralization. In lime softening, wellwater would undergo treatment with chemicals in a clarifier-softener to remove hardness and colloidal silica. This process would be followed by filtration and demineralization. The demineralizers would consist of strongly acidic cation exchanger followed by strongly basic anion exchanger. The final demineralizing step would be mixed bed ion exchange. Treated water would be pumped to the condenser hotwell or the demineralized water (condensate) storage tank. The ion exchange units would be regenerated with sulfuric acid and caustic. The regenerants would be pumped to a mixing tank so that the effluent from the tank would be essentially neutralized before it was discharged to the ash system.

Condensate being circulated through the feedwater system would be treated in a condensate polishing system. The polisher would remove PM such as oxide of iron (rust) picked up by the water during startups and dissolved solids that were introduced through condenser leaks. The result would be a relatively low level of total dissolved solids in the boiler water, which would assure production of a steam with sufficient purity to comply with turbine manufacturer standards.

Hydrazine and ammonia would be injected into the boiler to scavenge oxygen and control pH. The small amount of precipitates collected in the boiler drum would be blown down to a flash tank and the blowdown water would be delivered to the circulating water system for further use. Coordinated phosphate treatment could be used for fluidizing solids in the boiler drum.

2.0
FRAMEWORK FOR ANALYSIS

This section describes the methodology and approaches used in conducting the air quality analysis for the Environmental Impact Statement (EIS). Included is a discussion of applicable Federal and state regulations, and how these regulations relate to the EIS. Indicators of significant air quality impacts are defined, and the study area with respect to air quality is described.

2.1 RELATIONSHIP OF FEDERAL REGULATIONS TO THE ANALYSIS

2.1.1 Wilderness Act

The Wilderness Act of 1964 charges the Federal agency with jurisdiction over a wilderness area or proposed wilderness area with the administration of this area "...in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas..." Many activities and land uses are prohibited in wilderness areas (WAs), including roads, motorized equipment, mechanical transport, landing of aircraft, most commercial enterprises, and permanent structures and installations. With respect to potential air quality impacts from air pollution sources proposing to locate outside the boundaries of WAs, this review is typically provided for in Federal and state air quality planning and permitting programs. Federal WAs in the vicinity of the proposed Thousand Springs Power Plant (TSPP) are listed in Table 2-1. For the proposed TSPP, the U.S. Forest Service (USFS) has jurisdiction over the WAs listed in Table 2-1. The role of the USFS in the evaluation of the proposed TSPP project is described further in Sections 2.1.3.2 and 2.2.1.

2.1.2 Federal Land Policy and Management Act

The Federal Land Policy and Management Act of 1976 directs the Bureau of Land Management (BLM) to manage public lands and their resources under the principles of multiple use and sustained yield. This is to be done "...in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmosphere, water resource, and archaeological values." Section 603 of the act requires the BLM to review BLM roadless areas of 5000 or more acres and roadless islands. This process identifies wilderness study areas (WSAs) for possible designation to WAs, which can only occur by an act of Congress. Once designated, WAs would be administered in accordance with the Wilderness Act, but until Congress acts, the BLM's Interim Management Policy and Guidelines for Lands Under Wilderness Review (1979; rev. 1983) serves as the principal document

Table 2-1. WILDERNESS AREAS AND CURRENT DESIGNATION IN PROJECT AREA

U.S. Forest Service	Status
East Humboldt	WA
Jarbidge	WA[a]
Jarbidge Extension	WA
Ruby Mountains	WA
Bureau of Land Management	**Status**
Bluebell	WSA
Goshute	WSA
South Pequop	WSA
Badlands	WSA
Ruff Hills	WSA

[a] PSD Class I Area

WA = Wilderness Area

WSA = Wilderness Study Area

for managing WSAs. The goal of the interim management policy is to ensure that the wilderness qualities inherent to each WSA are unchanged at the time that Congress makes the final decisions, which can include existing air quality. Thus, potential air quality impacts from sources proposing to locate outside a WSA could be reviewed by the BLM. There are several WSAs in the vicinity of the proposed TSPP, as shown in Table 2-1. These WSAs are in the BLM's Wells Resource Area of the Elko District.

2.1.3 Clean Air Act

The major Federal law that governs the potential air quality impacts of the proposed TSPP project is the Clean Air Act, enacted in its current form in 1970, and amended in 1977. The Clean Air Act requires the U.S. Environmental Protection Agency (EPA) to establish national ambient air quality standards (NAAQS). These standards are determined by the EPA through a detailed procedure stipulated in the act. The procedure requires an independent review to be conducted by a committee composed of at least one member of the National Academy of Sciences, one physician, and one person representing state air pollution control agencies. This review includes assessments of epidemiological, toxicological, and plant and material damage studies. The assessments are then used by the EPA as a basis for selecting primary NAAQS to protect the public health, "allowing for an adequate margin of safety," as well as secondary NAAQS to protect the public welfare.

Air quality is considered acceptable if ground-level concentrations are continuously less than or equal to the NAAQS or, in the case of short-term Federal standards (24-hour average or less), exceed the standards no more than once each year. In addition, individual states can establish statewide ambient air quality standards as stringent or more stringent than the national standards. National and Nevada ambient air quality standards are listed in Table 2-2. Note that with respect to the particulate matter standards, the 24-hour national and Nevada standards have the same numerical value, but the national standard applies only to airborne particles with diameters less than 10 micrometers (μm) in diameter (PM_{10}) while the Nevada standard applies to all total suspended particulate matter (TSP). In addition, the national 24-hour PM_{10} standard allows one exceedance per calendar year, while the Nevada TSP standard is not to be exceeded at any time.

Existing air quality in all areas potentially affected by the proposed project is currently better than national and state air quality standards. That is, these areas are in "attainment" of the NAAQS. Two major Federal programs established by the Clean Air Act for proposed new sources of air pollution in "attainment areas" are new source performance standards (NSPS) and the prevention of significant deterioration (PSD).

2.1.3.1 New Source Performance Standards. NSPS are emission limitations codified in Title 40 of the Code of Federal Regulations, Part 60, that apply to specific types of proposed new pollutant emitting equipment. For electric utility steam generators, current NSPS limitations (40 CFR, Part 60, Subpart Da) are as follows:

Table 2-2. AMBIENT AIR QUALITY STANDARDS AND PSD INCREMENTS (MICROGRAMS PER CUBIC METER)

Pollutant and Averaging Time	National Ambient Air Quality Standards		Nevada Ambient Air Quality Standards	Class I PSD Increments[c]	Class II PSD Increments[c]
	Primary	Secondary			
Sulfur Dioxide					
3-hour[a]	--	1300	1300	25	512
24-hour[a]	365	365	365	5	91
Annual Arithmetic	80	80	80	2	20
Particulate Matter[b]					
24-hour[a]	150	150	150	10	37
Annual Geometric	50	50	75	5	19
Nitrogen Dioxide					
Annual Arithmetic	100	100	100	2.5	25
Carbon Monoxide					
1-hour[a]	40,000	40,000	40,000	--	--
8-hour[a]: < 5000' MSL	10,000	10,000	10,000	--	--
≥ 5000' MSL	10,000	10,000	6,670	--	--
Ozone					
1-hour[a]	235	235	235	--	--
Lead					
Quarterly Arithmetic	1.5	1.5	1.5	--	--
Hydrogen Sulfide					
1-hour[a]	--	--	112	--	--

[a] Short-term national standards and national and Nevada PSD increments (24 hours or less) are not to be exceeded more than once per year, at any location. Short-term Nevada standards are not to be exceeded at any time.

[b] National particulate matter standards apply to PM_{10}, Nevada particulate matter standards apply to TSP, and national and Nevada particulate matter PSD increments apply to TSP.

[c] PSD increments are exceeded if air quality impacts from all PSD sources in the area exceed these levels. PSD sources include all sources in the area for which a PSD permit is applied on or after the PSD baseline date. The baseline date is set by the first major source or major modification to apply for a PSD permit after August 7, 1977.

- Sulfur dioxide (SO_2) - 1.2 pounds per million Btu (lbs/MMBtu) and a minimum reduction of 90 percent of the potential combustion concentration; or 0.6 lbs/MMBtu and a minimum reduction of 70 percent of the potential combustion concentration.
- Oxides of nitrogen (NO_x) - 0.6 lbs/MMBtu for bituminous coals, 0.5 lbs/MMBtu for subbituminous coals, and a minimum reduction of 65 percent of the potential combustion concentration.
- Particulate matter - 0.03 lbs/MMBtu and a minimum reduction of 99 percent of the potential combustion concentration.
- Opacity - Less than 20 percent (6-minute average), except for one 6-minute period per hour of no more than 27 percent.

The NSPS regulations give minimum percent reduction requirements in terms of "potential combustion concentration." For SO_2, the "potential combustion concentration" is taken to be the SO_2 concentration in the combustion gases prior to the application of any sulfur removal or gas cleaning technology. Therefore, the minimum percent reduction for SO_2 given in the NSPS can be compared directly with the proposed SO_2 removal efficiency for the TSPP stack gases. For NO_x, the "potential combustion concentration" is defined in the NSPS regulations for solid fuel (coal) as 2.30 lbs/MMBtu. A minimum 65 percent reduction of this value would calculate to 0.80 lbs/MMBtu. This limitation is higher than the specific emission limits for NO_x given above for bituminous and subbituminous coals; thus, the specific NSPS emission limits for NO_x are more stringent for the proposed project than the minimum percent reduction in potential combustion concentration. Finally, for particulate matter, the NSPS regulations define the "potential combustion concentration" for solid fuel as 7.0 lbs/MMBtu; therefore, a 99 percent reduction of this value would give 0.07 lbs/MMBtu. Thus, the 0.03 lb/MMBtu emission limit for particulate matter given above would apply to the proposed TSPP since it is more stringent. With respect to other criteria and noncriteria air pollutants, there are no applicable NSPS emission limitations.

2.1.3.2 Prevention of Significant Deterioration. In addition to the requirement to achieve minimum national ambient air quality standards, the Clean Air Act outlines a special program for major sources proposing to locate in areas where existing air quality is better than the applicable air quality standards (attainment areas). This program is called PSD and is implemented by EPA-promulgated regulations found in Title 40 of the Code of Federal Regulations, Part 52, Section 21 (i.e., 40 CFR 52.21). The goal of the PSD regulations is to keep clean air relatively clean by limiting the amount of allowable air quality degradation in areas currently in attainment of the ambient standards. The regulations contain cumulative "increment" limits for ambient concentrations of SO_2, nitrogen dioxide (NO_2), and TSP that are allowed over existing "baseline" concentrations in the area. As new major sources of air pollution propose to locate in an "attainment" area, each new source "consumes" portions of the allowable increment. "Unclassified" areas (i.e., areas that cannot be classified with respect to ambient air quality standards) are treated as if they are attainment areas. For each pollutant, overall air quality degradation is limited to the amount of the remaining increment in the area or to the applicable ambient air quality standard, whichever is most restrictive. In Nevada, the authority to implement Federal PSD regulations has been delegated by the EPA to the Nevada Division of Environmental Protection (NDEP).

Available increments are location specific and, therefore, vary throughout the area where a major source (PSD source) is located. At any given location, the available increment depends on the amount consumed by a particular source. Multiple major sources can reside in the same general area as long as the cumulative concentration impacts at every location are below the increments and the ambient air quality standards are not violated. Increment consumption by multiple sources in a region is usually determined through air quality dispersion modeling.

Sources subject to PSD are required to include certain supporting analyses in their air pollution permit applications. The key PSD analyses include documentation that the proposed air pollution control systems constitute the "best available control technology" (BACT); an air quality impact analysis demonstrating that the ambient air quality standards and allowable air quality increments will not be exceeded; and a demonstration that the proposed source will not have an adverse impact on "air quality related values" (AQRVs) in Class I areas (designated national parks and national WAs). Each of these are summarized briefly below.

Best Available Control Technology. A PSD permit application must include documentation that the proposed air pollution emission control system represents BACT. The Clean Air Act denotes BACT as an emission limitation based on the maximum degree of reduction with respect to each pollutant, taking into account energy, environmental, and economic impacts, as well as other costs. BACT is required for each pollutant regulated under the Clean Air Act that exceeds certain threshold emission levels. These pollutants include "criteria pollutants," for which NAAQS have been established, and "noncriteria pollutants," for which no NAAQS exist but which are regulated under other sections of the Clean Air Act (such as National Emission Standards for Hazardous Air Pollutants [NESHAP] or NSPS). Control technology requirements that fulfill BACT are determined on a case-by-case basis, considering the type of source, precedent BACT determinations, potential energy penalties and environmental impacts associated with stringent control measures, and economic impacts. The BACT applied to a source must always control pollutant emissions to levels that are at least as stringent as NSPS.

As discussed in Section 5.1.1.2, an evaluation of alternative control technologies was performed for the proposed TSPP project. This analysis, however, is not intended to be a complete BACT analysis. Such an analysis will be submitted with the proposed project's PSD permit application to the NDEP, and the authority to establish final BACT emission limitations is with the NDEP. The proposed emission limitations presented in this Technical Report and associated EIS are the applicant's best current assessment of BACT for the proposed project.

Because the TSPP project consists of eight individual construction phases that would take place over a period of approximately 20 years, it would be considered a "phased construction" project with respect to PSD regulations. The PSD regulations require that the determination of BACT be reviewed prior to implementation of each independent construction phase. Specifically, under PSD regulations [40 CFR 52.21 (j) (4)], the following would apply to the proposed TSPP project:

> For phased construction projects, the determination of best available control technology shall be reviewed and modified as appropriate at the latest reasonable time which occurs no later than 18 months prior to commencement of construction of each independent phase of the project. At such time, the owner or operator of the applicable stationary source may be required to demonstrate the adequacy of any previous determination of best available control technology for the source.

Air Quality Impact Analysis. The PSD applicant must submit an air pollution dispersion modeling analysis demonstrating that the proposed source would not cause or contribute to a violation of any applicable ambient air quality standard or any allowable air quality increment. The ambient air quality standards analysis is a general indicator of significance for any project since ambient air quality standards are designed to protect the public health with an adequate margin of safety. The air quality increments analysis is an indicator of significance particular to the proposed PSD source, where the focus is protecting the quality of the existing clean air. In attainment areas, the applicable air quality increments depend on the classification of the area. All attainment areas can be designated into one of three classifications:

- Class I areas, where the most stringent degree of protection from future air quality degradation applies
- Class II areas, where a moderate degree of protection from future air quality degradation applies
- Class III areas, where a lesser degree of protection from future air quality degradation applies

At the present time, there are no areas in the U.S. designated as Class III. Current Class I areas include the following areas which were in existence at the time of the adoption of the Clean Air Act Amendments (August 7, 1977): international parks, national WAs exceeding 5000 acres in size, national memorial parks exceeding 5000 acres in size, and national parks exceeding 6000 acres in size. All other attainment areas in the U.S. are currently designated as Class II. A listing of allowable Class I and Class II PSD air quality increments can be found in Table 2-2.

As discussed in Section 2.4, the air quality study area for the proposed TSPP is designated as Class II. In addition, there is one Class I area in the State of Nevada potentially impacted by the proposed project, Jarbidge Wilderness Area, approximately 75 km (47 miles) northwest from the proposed project site.

Air Quality Related Values (AQRVs). The EPA regulations provide for additional protection of AQRVs in PSD Class I areas. The regulations allow a "Federal Land Manager" (FLM) to recommend denial of a PSD permit application to the EPA Administrator or his designee if the proposed source can be shown to have an adverse impact on AQRVs. For the proposed TSPP, the potentially impacted Class I area is Jarbidge Wilderness Area, for which the FLM is the USFS "Regional Forester," who supervises the Intermountain Region National Forests in Nevada, Utah, and parts of Idaho, Wyoming, Colorado, and California. A general listing of the USFS AQRVs is given below along with associated physical parameters whose changes can be used to judge whether significant impacts could occur as a result of changes in air quality (USFS 1987a):

- Water
  - pH
  - Metals concentration
  - Total alkalinity
- Flora and Fauna
  - Growth
  - Mortality
  - Reproduction
  - Diversity
  - Visible injury
  - Succession
  - Productivity
- Soil
  - Cation exchange capacity
  - Base saturation percent
  - pH
  - Structure
  - Metals concentration
- Odor
  - Odor
- Visibility
  - Contrast

  - Coloration
  - Visual range

- Cultural/archaeological resources
  - Deposition
  - Decomposition

- Geologic resources
  - Deposition
  - Decomposition

For the proposed TSPP project, the USFS has identified sensitive receptors and limits of acceptable change (LACs) for the following AQRVs from the above list: water, flora, fauna, and visibility (USFS 1989a). These are described in Section 2.3.2.

2.2 RELATIONSHIP OF ANALYSIS TO STATE AIR QUALITY PERMITTING

2.2.1 Prevention of Significant Deterioration

Air quality regulations for the State of Nevada (codified in the Nevada Administrative Code [NAC]) adopt the Federal PSD regulations by reference at NAC 445.6605. As stated in Section 2.1.3.2, the EPA has delegated authority to the NDEP to implement the Federal PSD regulations; thus, the PSD permit application for the proposed TSPP will be submitted to the NDEP for review. The USFS review of AQRV impacts will be coordinated by the NDEP.

2.2.2 Other Criteria Air Pollutant Requirements

In addition to PSD requirements, the proposed TSPP must comply with specific emission limitations contained in the NAC for criteria air pollutants. These limitations include the following:

NAC 445.731 Particulates. Limits emissions of particulate matter from fuel-burning equipment using indirect heat transfer. For heat inputs greater than 10 MMBtu/hr, but less than 4000 MMBtu/hr, the particulate matter emission limit is given by:

$$Y = 1.02X^{-0.231}$$

where X = operating rate in MMBtu/hr
Y = allowable emission rate of particulate matter in lbs/MMBtu

NAC 445.753 Sulfur: For sources with a total input of heat equal to or greater than 250 MMBtu/hr heat input, the allowable sulfur emissions are limited to:

$$Y = 0.6X$$

where X = maximum heat input in MMBtu/hr

Y = allowable emission rate of sulfur in lbs/hr.

2.2.3 Air Toxics

NAC 445.717 through 445.7205 contain criteria for evaluating emissions of toxic or hazardous air contaminants from stationary sources. An air contaminant is defined as toxic or hazardous under one of two conditions: it has been assigned a Threshold Limit Value (TLV) by the American Conference of Governmental Industrial Hygienists, based on its toxic properties in humans; or it has been determined by the Director of the Nevada State Department of Conservation and Natural Resources to cause or contribute to air pollution such that exposure may result in increased mortality or irreversible morbidity. The second condition is waived for cases in which an adopted state or Federal ambient air quality standard, an NSPS under 40 CFR Part 60, or a NESHAP under 40 CFR Part 61 applies to the contaminant.

Acceptable concentrations of toxic or hazardous air contaminants for the quality of ambient air (ACQAA) are derived by dividing the TLVs (or other toxic factor [TF] determined by the NDEP) by a factor of 42. This factor is used to account for differences in work shifts and work requirements, as well as for individual variation among members of the general public. Since TLVs are based on an 8-hour work day, the averaging time for an ACQAA must be comparable. For those contaminants which do not have a TLV or TF, the Director will determine toxicity based on an accepted or reasonable methodology. Compliance with ACQAAs must be demonstrated through ambient air monitoring and/or emission sampling and/or dispersion modeling techniques. A predicted or demonstrated exceedance of an ACQAA based on uncontrolled emissions requires the application of the best available control technology for the applicable toxic or hazardous air pollutant to achieve compliance with the ACQAA.

2.3 INDICATORS OF SIGNIFICANCE

This section describes the criteria used in this Technical Report and associated EIS to judge whether a projected air quality impact from the proposed TSPP would be significant.

2.3.1 Criteria Air Pollutants

Increases in ambient air concentrations of criteria pollutants that would result from the proposed TSPP are added to appropriate background concentration levels to predict total ambient concentrations. These predicted levels are then compared with applicable state and Federal ambient air quality standards. These standards provide levels that are considered to represent concentrations below which human health and general welfare are not endangered. As such, they are used in this Technical Report and associated EIS as indicators of impact significance.

In addition, the proposed TSPP is subject to PSD requirements, thus allowable air quality degradation from the proposed TSPP must not exceed the air quality increment values shown in Table 2-2. The air quality study area for the proposed TSPP project is located in a region classified as Class II; thus, for this area, the Class II air quality increments given in Table 2-2 constitute indicators of impact significance. The proposal project may also have a potential air quality impact on Jarbidge Wilderness Area, a Class I area; thus, for Jarbidge Wilderness Area, the Class I increments given in Table 2-2 are used as indicators of impact significance.

2.3.2 Air Quality Related Values

In its air resource management program for Jarbidge Wilderness Area (USFS 1987b), the USFS has identified AQRVs, along with sensitive receptors, and has developed specific LACs for Jarbidge. According to the USFS, "Until there is sufficient baseline AQRV data to statistically define the air pollution effects found in the Jarbidge Class I area, the FLM has defined the LAC for AQRVs to be a measurable change from the present condition." Thus, the LACs set for this Class I area are defined in terms of an incremental quantity above the current background levels. Table 2-3 lists the AQRVs and LACs that have been defined for Jarbidge Wilderness Area. These LACs are used as indicators of impact significance in the Class I Jarbidge Wilderness Area.

In addition to the specific LACs for Jarbidge Wilderness Area, the USFS has general AQRV guidelines for the management of Class I areas (USFS 1989b) and has indicated other AQRVs and LACs that would be applicable when evaluating air quality impacts from the proposed TSPP project (USFS 1989a). These additional AQRV and LAC guidelines are also provided in Table 2-3.

LACs have not been set for WAs located in PSD Class II areas. The Clean Air Act only specifies that AQRVs shall be protected in Class I areas. For WAs located in Class II areas, the applicable criteria for determining impact significance are the national and state ambient air quality standards. Although LACs for Class I areas do not directly apply to Class II areas, they can be used for comparison purposes.

2.3.3 Air Toxics

Section 2.2.3 discusses how the NAC provides for the establishment of ACQAA for toxic or hazardous air contaminants. For the proposed TSPP, predicted concentrations of applicable toxic or hazardous air contaminants in excess of any established ACQAA (assuming emission controls) would be an indicator of significant impact.

2.4 AIR QUALITY STUDY AREA

In order to comply with the requirements of the Clean Air Act and NEPA, the air quality study area is defined by an area bounded by the maximum extent of a "significant" impact. "Significant" impact levels have been defined by the EPA as specific pollutant concentrations below which no interference with an ambient air quality standard is assumed, even in areas where a standard is currently being violated. These concentration levels are given in Table 2-4.

Table 2-3. AIR QUALITY RELATED VALUES AND LIMITS OF ACCEPTABLE CHANGE

Air Quality Related Value	Sensitive Receptor	Limit of Acceptable Change
Jarbidge Wilderness Area[a]		
Water	lake alkalinity	0.1 of a pH unit
Flora	lichens	5 kg/ha-yr of depositional sulfate
Visibility	visual range, fine particulates	5 percent visibility change
General FS Wilderness/AQRV[b] Management Guidelines		
Water	lake alkalinity	5 kg/ha-yr total depositional sulfur
Flora	lichens	5 kg/ha-yr total depositional sulfur
Fauna	macrobiotic aquatic insects	3-5 kg/ha-yr total nitrogen deposition
		35 ppb ozone (growing season average
		75 ppb ozone (highest 1-hr. average per year)
Visibility	visual range reduction, fine particulates	5 percent visual range decrease

[a] Source: USFS 1987b
[b] Source: USFS 1989a

To convert from sulfur to sulfate, multiply by 3.

To convert from nitrogen to nitrate, multiply by 4.4.

Table 2-4. EPA SIGNIFICANCE LEVELS FOR AIR QUALITY IMPACTS

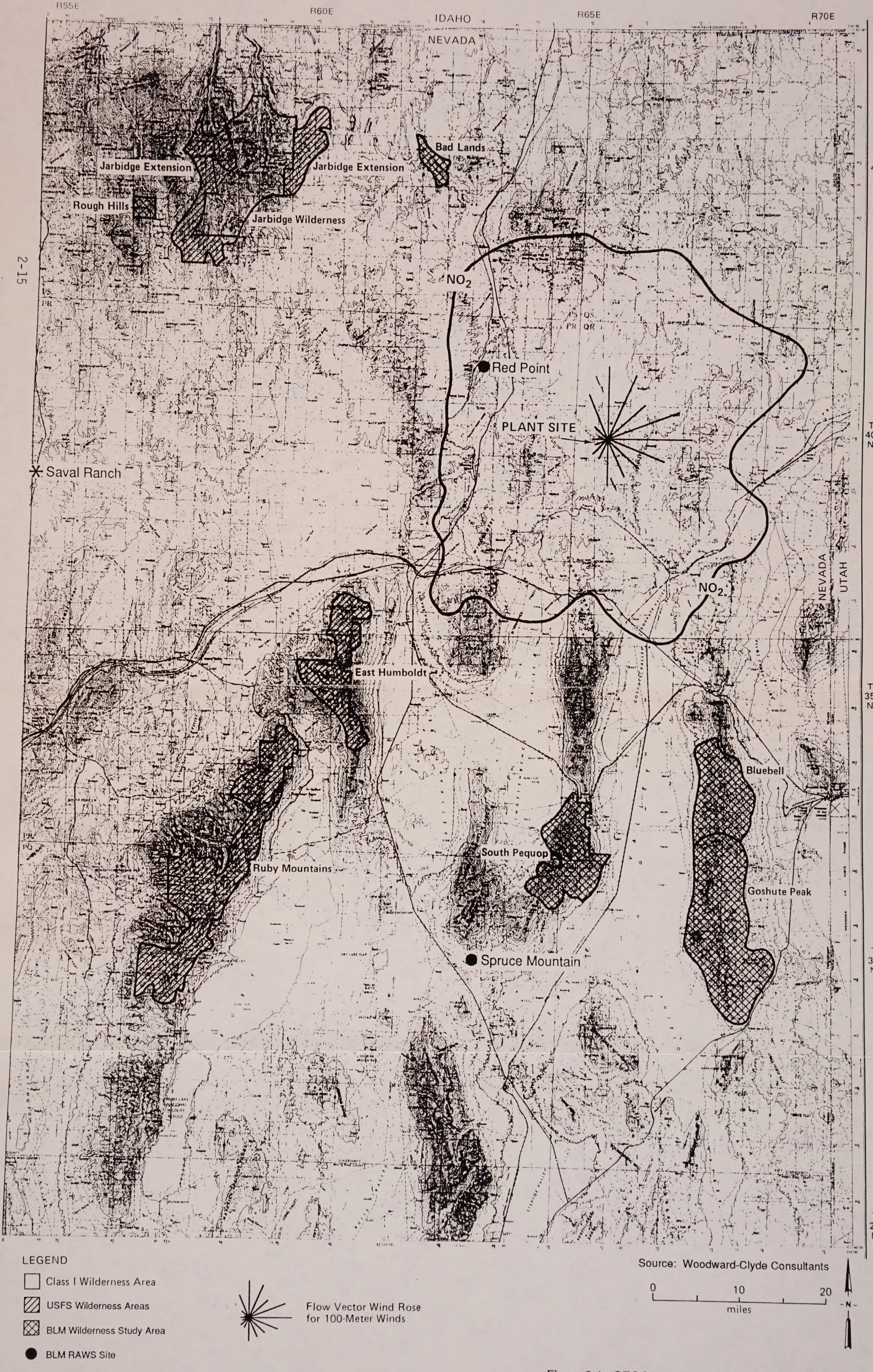
	Averaging Time				
Pollutant	Annual ($\mu g/m^3$)	24-hour ($\mu g/m^3$)	8-hour ($\mu g/m^3$)	3-hour ($\mu g/m^3$)	1-hour ($\mu g/m^3$)
Sulfur Dioxide	1	5	--	25	--
Total Suspended Particulates	1	5	--	--	--
Nitrogen Dioxide	1	--	--	--	--
Carbon Monoxide	--	--	500	--	2000

Source: 40 CFR Part 51, Appendix S.

For the purposes of the EIS, the largest area within an annual average 1 $\mu g/m^3$ isopleth (line of constant concentration) for SO_2, NO_2, or TSP is used to represent the calculated study area. Based on air quality modeling results, the largest annual average 1 $\mu g/m^3$ isopleth was for NO_2. Figure 2-1 shows the predicted study area (1 $\mu g/m^3$ isopleth for NO_2) for the proposed TSPP project. This entire area is classified as PSD Class II. Figure 2-1 also shows other WAs and WSAs in the region that the USFS and BLM have identified to be of concern with respect to potential air quality impacts from the proposed TSPP. In addition, there is one PSD Class I area, Jarbidge Wilderness Area, located within 100 kilometers (km) (62 miles) of the proposed TSPP. Emissions from the proposed TSPP could pose a potential impact to this Class I area; thus, it is a special area of concern, and detailed air quality and AQRV analyses were performed.

Typically, the EPA only requires a detailed air quality and air quality related value analysis for Class I areas if a proposed PSD source plans to locate within 100 km of it. The next closest Class I area or proposed Class I area from the TSPP site is Craters of the Moon National Monument (about 240 km from TSPP). In addition to Craters of the Moon, there are a number of Class I areas beyond 100 km from the proposed TSPP site. Figure 2-2 shows the Class I areas where visibility is an important value that are within 300 miles (500 km) of the proposed TSPP site along with the WAs within 100 km of the site. A number of these Class I areas were also evaluated for potential air quality effects from TSPP emissions. The approximate distances from the proposed TSPP site to each of the areas shown on Figure 4-2 are given in Table 2-5.

Emissions of carbon dioxide from the proposed TSPP are also of concern (i.e., the "Greenhouse Effect"). These impacts may be of a global nature and as such, no specific study area was defined.



Source: Woodward-Clyde Consultants

Figure 2-1. GEOGRAPHIC AREA OF INFLUENCE AND WILDERNESS AREAS IN REGION

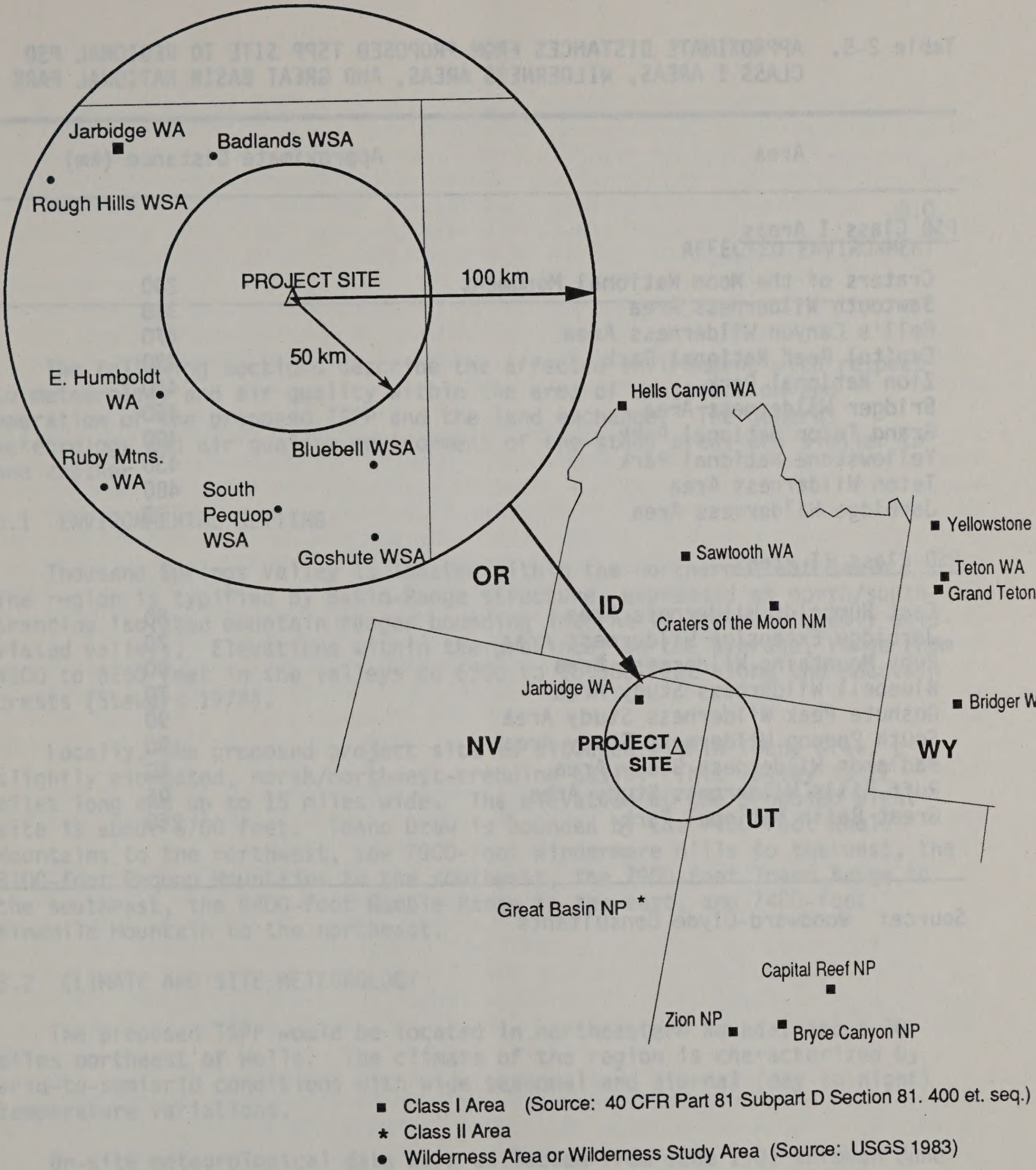


Figure 2-2. WILDERNESS AREAS AND WILDERNESS STUDY AREAS OF CONCERN IN THE PROJECT REGION (INSET) AND MANDATORY CLASS I AREAS WHERE VISIBILITY IS AN IMPORTANT VALUE WITHIN APPROXIMATELY 300 MILES (500 KILOMETERS) OF THE TSPP SITE

Table 2-5. APPROXIMATE DISTANCES FROM PROPOSED TSPP SITE TO REGIONAL PSD CLASS I AREAS, WILDERNESS AREAS, AND GREAT BASIN NATIONAL PARK

Area	Approximate Distance (km)
PSD Class I Areas	
Craters of the Moon National Monument	240
Sawtooth Wilderness Area	310
Hell's Canyon Wilderness Area	470
Capitol Reef National Park	430
Zion National Park	440
Bridger Wilderness Area	460
Grand Teton National Park	400
Yellowstone National Park	430
Teton Wilderness Area	480
Jarbidge Wilderness Area	75
PSD Class II Areas	
East Humboldt Wilderness Area	60
Jarbidge Extension Wilderness Area	70
Ruby Mountains Wilderness Area	90
Bluebell Wilderness Study Area	70
Goshute Peak Wilderness Study Area	90
South Pequop Wilderness Study Area	80
Badlands Wilderness Study Area	60
Ruff Hills Wilderness Study Area	95
Great Basin National Park	260

Source: Woodward-Clyde Consultants

3.0
AFFECTED ENVIRONMENT

The following sections describe the affected environment with respect to meteorology and air quality within the area of construction and operation of the proposed TSPP and the land exchange. The general meteorology and air quality environment of the study areas are similar to one another.

3.1 ENVIRONMENTAL SETTING

Thousand Springs Valley is located within the northern Great Basin. The region is typified by Basin-Range structure, expressed as north/south-trending isolated mountain ranges bounding internally drained, deeply alluviated valleys. Elevations within the province, on the average, range from 4300 to 5250 feet in the valleys to 6500 to 10,000 feet along the mountain crests (Stewart 1978).

Locally, the proposed project site is situated within Toano Draw, a slightly elongated, north/northwest-trending basin. This valley is 22 miles long and up to 15 miles wide. The elevation at the proposed plant site is about 5700 feet. Toano Draw is bounded by the 7400-foot Knoll Mountains to the northwest, the 7900-foot Windermere Hills to the west, the 8100-foot Pequop Mountains to the southwest, the 7900-foot Toano Range to the southeast, the 8400-foot Gamble Range to the east, and 7400-foot Ninemile Mountain to the northeast.

3.2 CLIMATE AND SITE METEOROLOGY

The proposed TSPP would be located in northeastern Nevada, about 30 miles northeast of Wells. The climate of the region is characterized by arid-to-semiarid conditions with wide seasonal and diurnal (day to night) temperature variations.

On-site meteorological data were collected from June 1981 through June 1982 and are also currently being collected (since September 1988). The meteorological and air quality monitoring station was, and is, located near the proposed TSPP site. A 100-meter tower was installed and used to collect meteorological data during the 1981-1982 monitoring period at two levels, 10 and 100 meters. During the 1981-1982 monitoring period, hourly windspeed, wind direction, and the standard deviation of the horizontal wind direction (σ_θ) data were collected at both levels. Hourly average temperature and relative humidity data were collected at the 10-meter level. Precipitation, pan evaporation, and the aerosol scattering coefficient (B-scat) data were also collected at the site. Hourly B-scat values were used to calculate visual ranges. Currently, a 10-meter tower is being used to collect the following meteorological data at the monitoring station: windspeed and direction, temperature, and the standard deviation of the horizontal wind direction (σ_θ) at the 10-meter level, and precipitation at ground level.

The data collected on site during the 1981-1982 monitoring period are compared to available long-term data from Elko, Nevada in the following sections to provide a description of the meteorology and climate in the vicinity of the proposed power plant site.

Additional meteorological data in the project region are available from Remote Automatic Weather Stations (RAWS) operated by the Bureau of Land Management (BLM). Data from two of these stations, Red Point and Spruce Mountain, are also provided for comparison purposes. Both stations collect windspeed, wind direction, precipitation, temperature, relative humidity, plus other information. These stations have been operating since September 1986. Data are presented for the period from September 1986 through December 1988. The Red Point station is located approximately 17 miles northwest of the proposed project site, while the Spruce Mountain Station is located approximately 63 miles south-southwest of the proposed project site, near the town of Currie. The locations of these stations are shown on Figure 2-1.

3.2.1 Temperature

The annual average temperature measured at the proposed TSPP site over the 1981-1982 time period was 46°F. A large seasonal temperature variation is evidenced by comparing the highest mean monthly temperature of 72°F during July 1981 to the lowest mean monthly temperature of approximately 24°F during January 1982. The maximum hourly average temperature during the year was 95°F, occurring on July 5, 1981, while a minimum temperature of -13°F occurred on February 5, 1982 (WCC 1982). Diurnal temperature variations can also be large, particularly during the summer. Average monthly diurnal temperature differences ranged from 17°F during the winter months to 39°F during the summer months of the 1981-82 monitoring year.

In Elko, located about 70 miles west from the proposed TSPP site, the annual average temperature is approximately 46°F, based on a 30-year period of record. The annual average daily maximum temperature is 62°F, and the annual average daily minimum temperature is 30°F (U.S. Department of Commerce [USDC] 1987), which results in an average diurnal variation of 32°F. Average monthly diurnal temperature variations range from 24°F during the winter to 41°F during the summer. The seasonal temperature difference at Elko is similar to that observed at the TSPP site, as indicated by a mean temperature of 70°F in July and a mean temperature of 24°F in January.

At the Red Point RAWS site, the annual average temperature is approximately 46°F, based on the 1986-1988 data. The annual average daily maximum temperature is 58°F, and the annual average daily minimum temperature is 33°F, resulting in an average diurnal variation of 25°F. At the Spruce Mountain RAWS site, the annual average temperature is approximately 47°F, also based on 1986-1988 data. The annual average daily maximum temperature is 59°F, and the annual average daily minimum temperature is 34°F, resulting in an average diurnal variation of 25°F. Average monthly diurnal temperature variations range from 20°F during winter to 31°F in summer at Red Point, and from 20°F during winter to 29°F in summer at Spruce Mountain.

3.2.2 Precipitation

Annual precipitation totals are quite low in the vicinity of the proposed TSPP site due to the presence of the Sierra Nevada mountains and numerous smaller mountain ranges to the west. These mountains effectively block much of the westerly flow of moisture from the Pacific Ocean to the lower elevation areas of Nevada. Based on a climatological averaging period of 30 years, 1957-1986, Elko receives an annual average precipitation total of 9.30 inches. The year-to-year variation in annual precipitation is large at Elko, ranging from under 5 inches in 1974 to over 18 inches in 1983 (USDC 1987). Only 5.01 inches of precipitation were received at the on-site meteorological station for the monitoring year of 1981-1982. The relatively low annual precipitation total at the on-site meteorological station falls within the range of the large year-to-year variations evident from the Elko climatological data.

Annual average precipitation at the Red Point and Spruce Mountain RAWS stations for the 1986-1988 period was 4.6 and 4.8 inches, respectively.

Northwest of the TSPP site are the more mountainous regions of Jarbidge Wilderness Area, where, based on 25 years of precipitation data, annual average precipitation at Pole Creek is 24.5 inches (U.S. Department of Agriculture [USDA] Soil Conservation Service [SCS] 1989). This annual average precipitation in Jarbidge Wilderness Area indicates, as might be expected, that precipitation is enhanced with increased elevation. Elevations in Jarbidge Wilderness Area range from about 7000 to 11,000 feet.

A comparison of average monthly and annual precipitation measured at Jarbidge, Elko, Red Point, Spruce Mountain, and the TSPP site is presented in Table 3-1.

The average number of days per year at Elko with snowfalls of 1-inch accumulation or more is only 14. Average total snowfall for the year is 38.2 inches. The number of months at Elko in which total monthly snowfall exceeded 20 inches was only 3 during the climatological period of 1957 to 1986.

Table 3-1. AVERAGE MONTHLY AND ANNUAL PRECIPITATION (IN INCHES) AT ELKO, JARBBIDGE WILDERNESS (POLE CREEK), TSPP, RED POINT, AND SPRUCE MOUNTAIN

Period	Elko[a] (5050 ft msl)	Jarbidge[a] (8330 ft msl)	TSPP[b] (5700 ft msl)	Red Point[c] (6029 ft msl)	Spruce Mtn.[c] (6100 ft msl)
January	1.0	2.2	0.19	0.1	0.3
February	0.8	2.7	0.02*	0.1	0.1
March	0.9	2.0	1.31	0.5	0.4
April	0.8	1.7	0.29	0.4	0.3
May	1.0	2.5	0.18	1.4	1.0
June	1.0	2.4	0.30*	0.5	0.6
July	0.4	1.0	--*	0.1	0.5
August	0.7	1.0	0.56	0.1	0.1
September	0.7	1.7	0.06	0.3	0.1
October	0.8	1.9	0.34	0.4	0.7
November	1.1	2.7	0.78	0.5	0.6
December	1.2	2.7	1.03	0.1	0.1
Annual	10.4	24.5	5.0*	4.6	4.8

Sources: USDC 1987; SCS 1989; WCC 1982; BLM 1989

* Incomplete data

[a] Period of record: 1961-1985

[b] Period of record: August 1981-June 1982

[c] Period of record: September 1986-December 1988

3.2.3 Wind

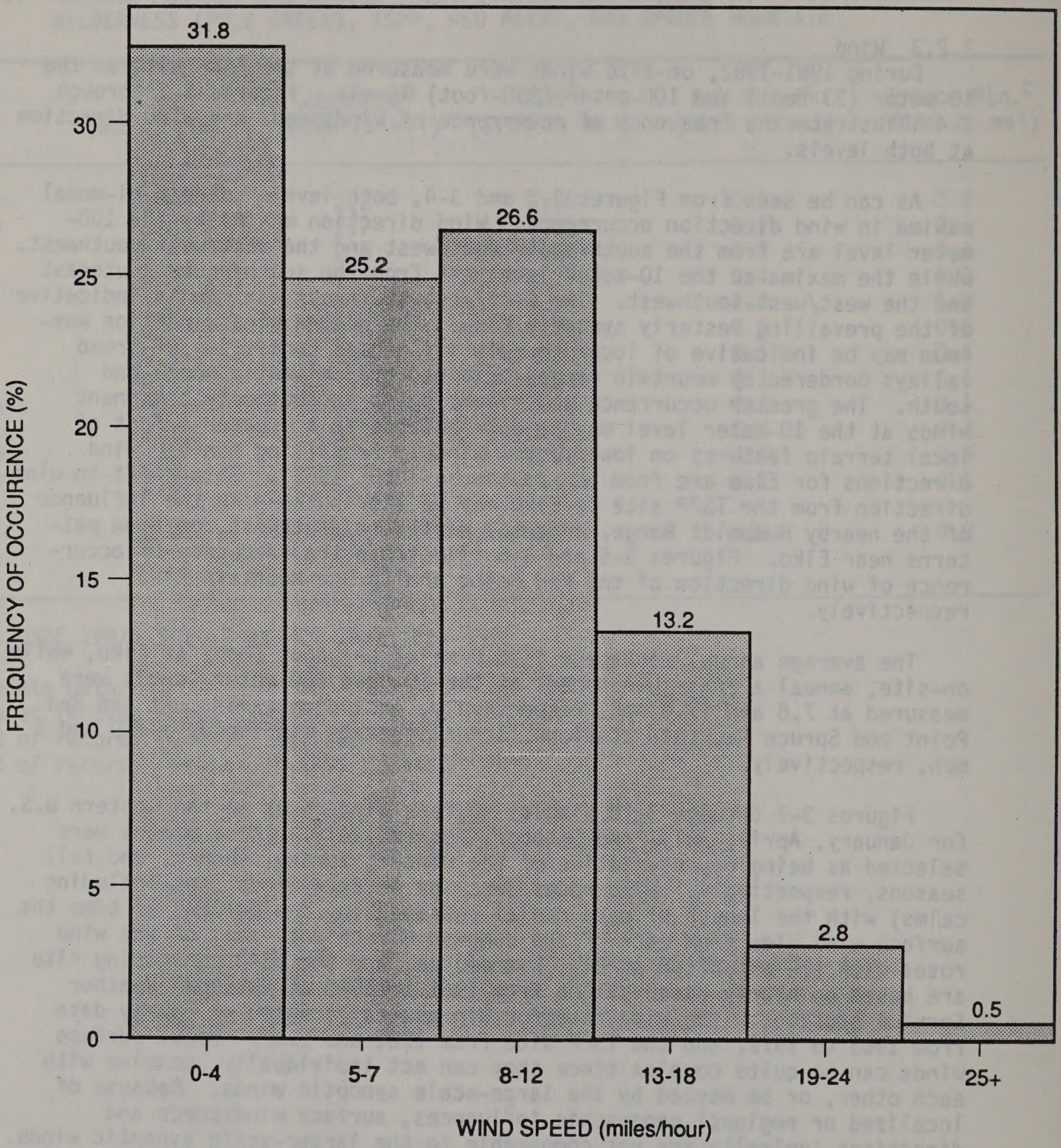
During 1981-1982, on-site winds were measured at the TSPP site at the 10-meter (33-foot) and 100-meter (330-foot) levels. Figures 3-1 through 3-4 illustrate the frequency of occurrence of windspeeds and wind direction at both levels.

As can be seen from Figures 3-2 and 3-4, both levels share a bi-modal maxima in wind direction occurrence. Wind direction maxima at the 100-meter level are from the south/south-southwest and the west/west-southwest, while the maxima at the 10-meter level are from the south/south-southeast and the west/west-southwest. The west/west-southwest maximum is indicative of the prevailing westerly synoptic flow. The second wind direction maximum may be indicative of local terrain influences consisting of broad valleys bordered by mountain ranges oriented predominantly north and south. The greater occurrence and slight shift in southerly component winds at the 10-meter level may be attributable to a greater effect of local terrain features on lower level winds. Prevailing monthly wind directions for Elko are from the southwest (USDC 1987). This shift in wind direction from the TSPP site to Elko may be attributable to the influence of the nearby Humboldt Range, oriented northeast/southwest, on flow patterns near Elko. Figures 3-5 and 3-6 illustrate the frequency of occurrence of wind direction of the Red Point and Spruce Mountain RAWS, respectively.

The average annual windspeed is 6.0 miles per hour (mph) at Elko, while on-site, annual average windspeeds at the 10- and 100-meter levels were measured at 7.6 and 11.0 mph, respectively, excluding calms. At the Red Point and Spruce Mountain stations, annual average windspeeds are 9 and 8 mph, respectively.

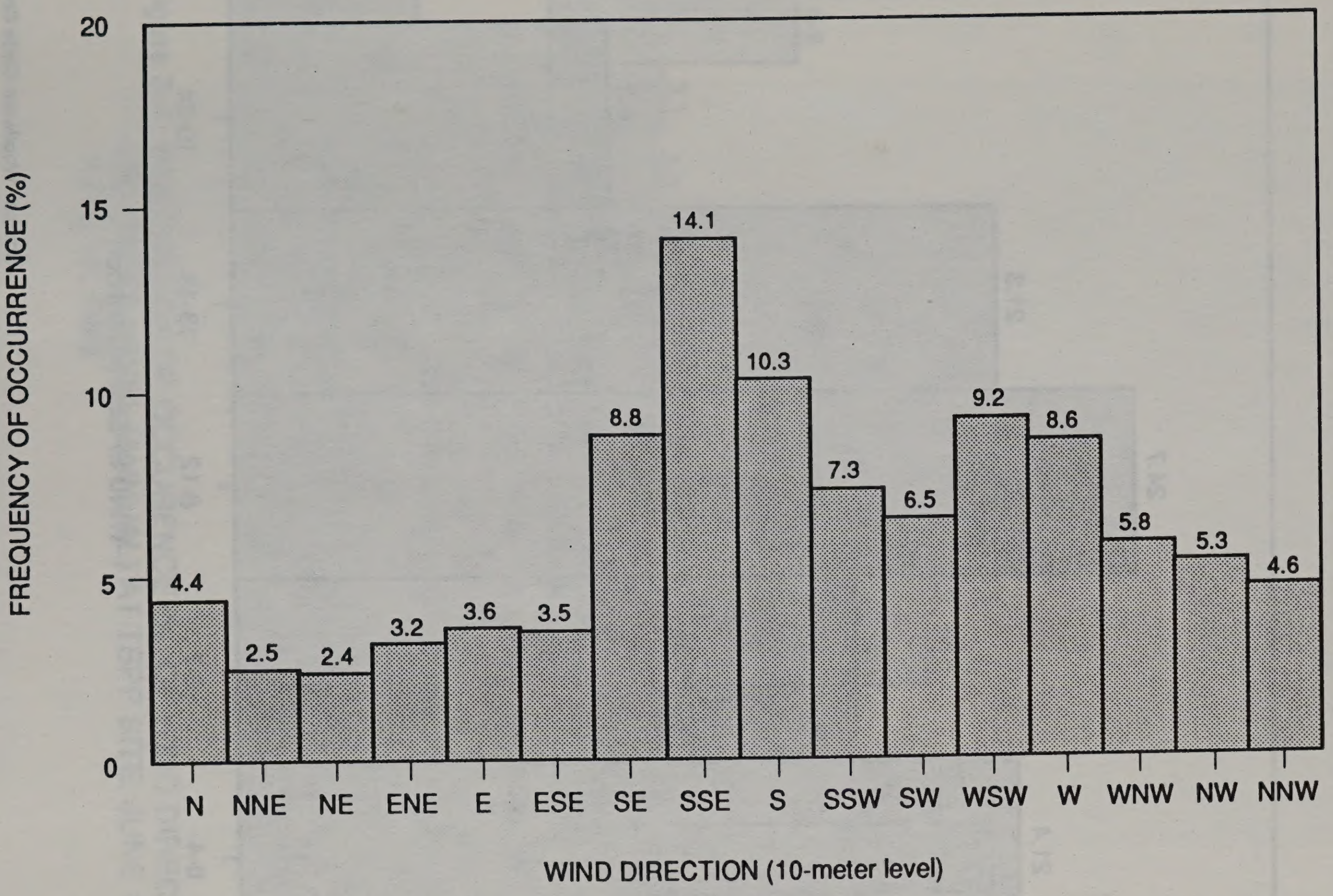
Figures 3-7 through 3-10 display surface wind roses in the western U.S. for January, April, July, and October, respectively. These months were selected as being representative of the winter, spring, summer, and fall seasons, respectively. Wind roses describe surface winds (not including calms) with the length of each radial representing the percent of time the surface wind blew from each of the compass directions. All of the wind roses with the exception of Ely, Winnemucca, and the TSPP monitoring site are based on hourly observations from 1951 to 1960 at National Weather Service stations. The wind rose for Winnemucca is based on hourly data from 1965 to 1972, and the TSPP site from 1981 and 1982. Local surface winds can be quite complex since they can act individually, combine with each other, or be masked by the large-scale synoptic winds. Because of localized or regional geographic influences, surface windspeeds and directions typically are not comparable to the larger-scale synoptic winds.

During high pressure patterns, winds tend to be weak, and the driving mechanisms for air movement can be locally induced by terrain and diurnal temperature differences. Several examples of local influences can be seen on Figures 3-7 through 3-10. Winds in Salt Lake City are characterized by a southwest prevailing wind direction, primarily due to the north-south



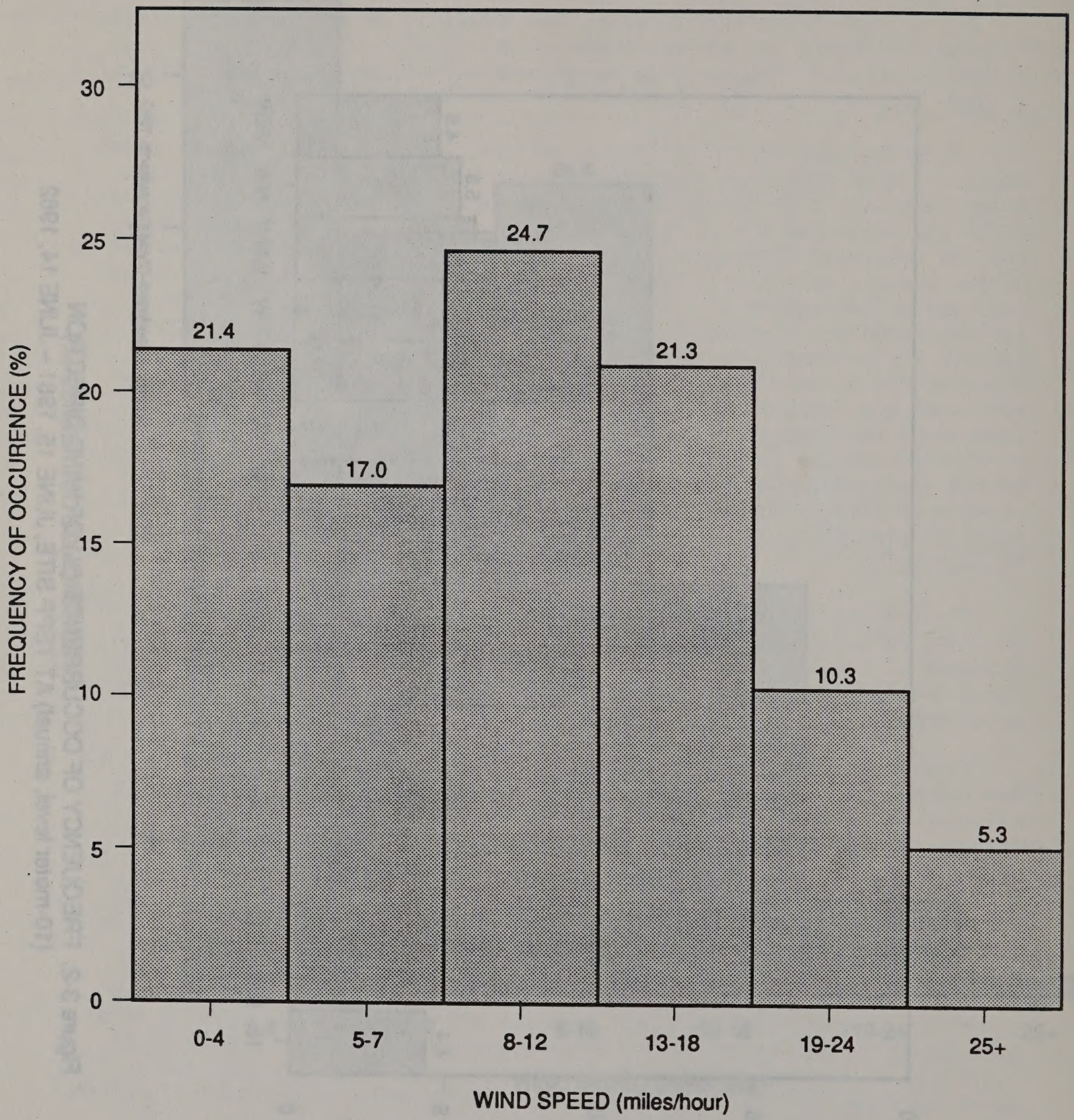
Source: Woodward-Clyde Consultants 1982

Figure 3-1. FREQUENCY OF OCCURRENCE (%) OF WIND SPEED, 10-METER LEVEL (ANNUAL) AT TSPP SITE, JUNE 15, 1981 – JUNE 14, 1982



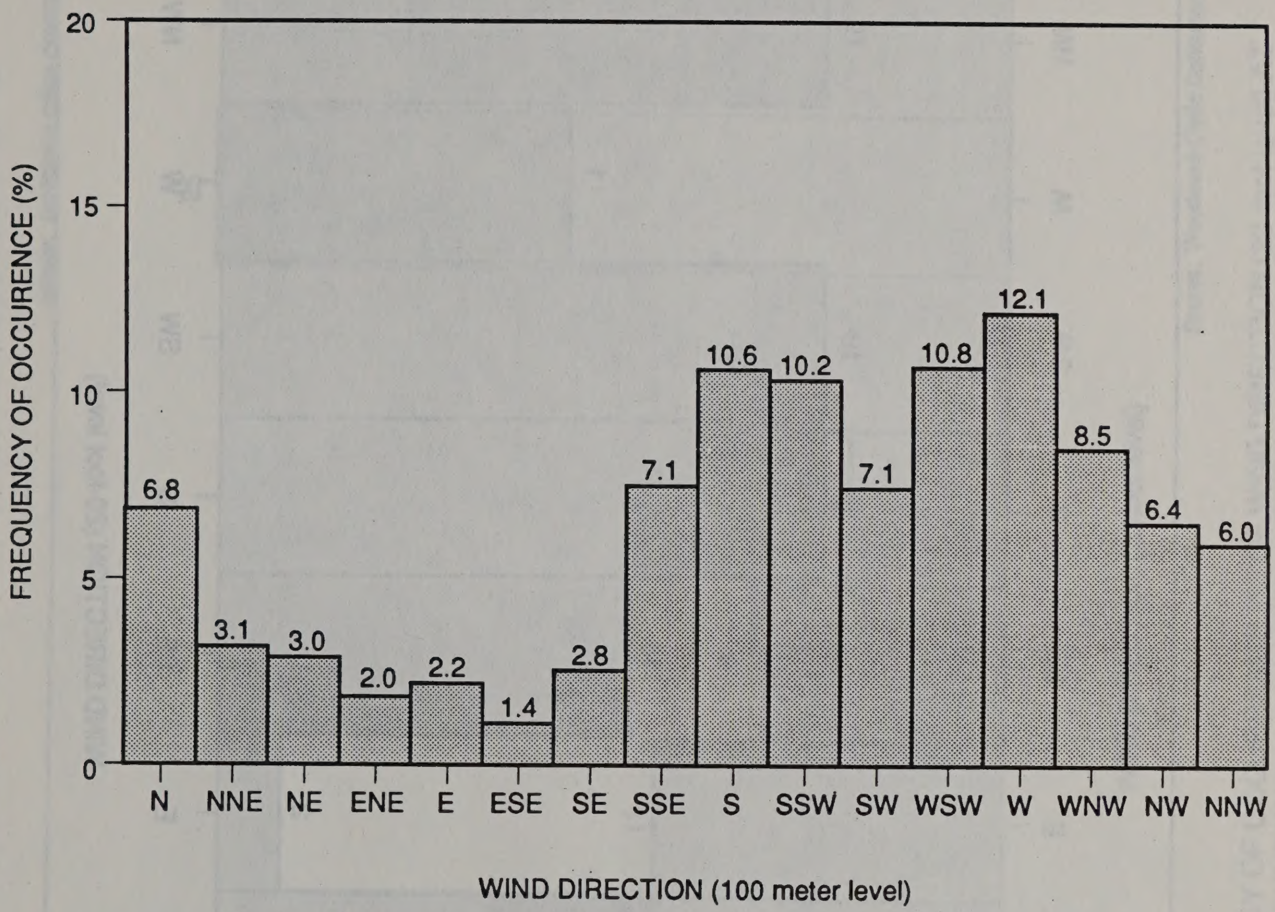
Source: Woodward-Clyde Consultants 1982

Figure 3-2. FREQUENCY OF OCCURRENCE (%) OF WIND DIRECTION (10-meter level, annual) AT TSPP SITE, JUNE 15, 1981 – JUNE 14, 1982



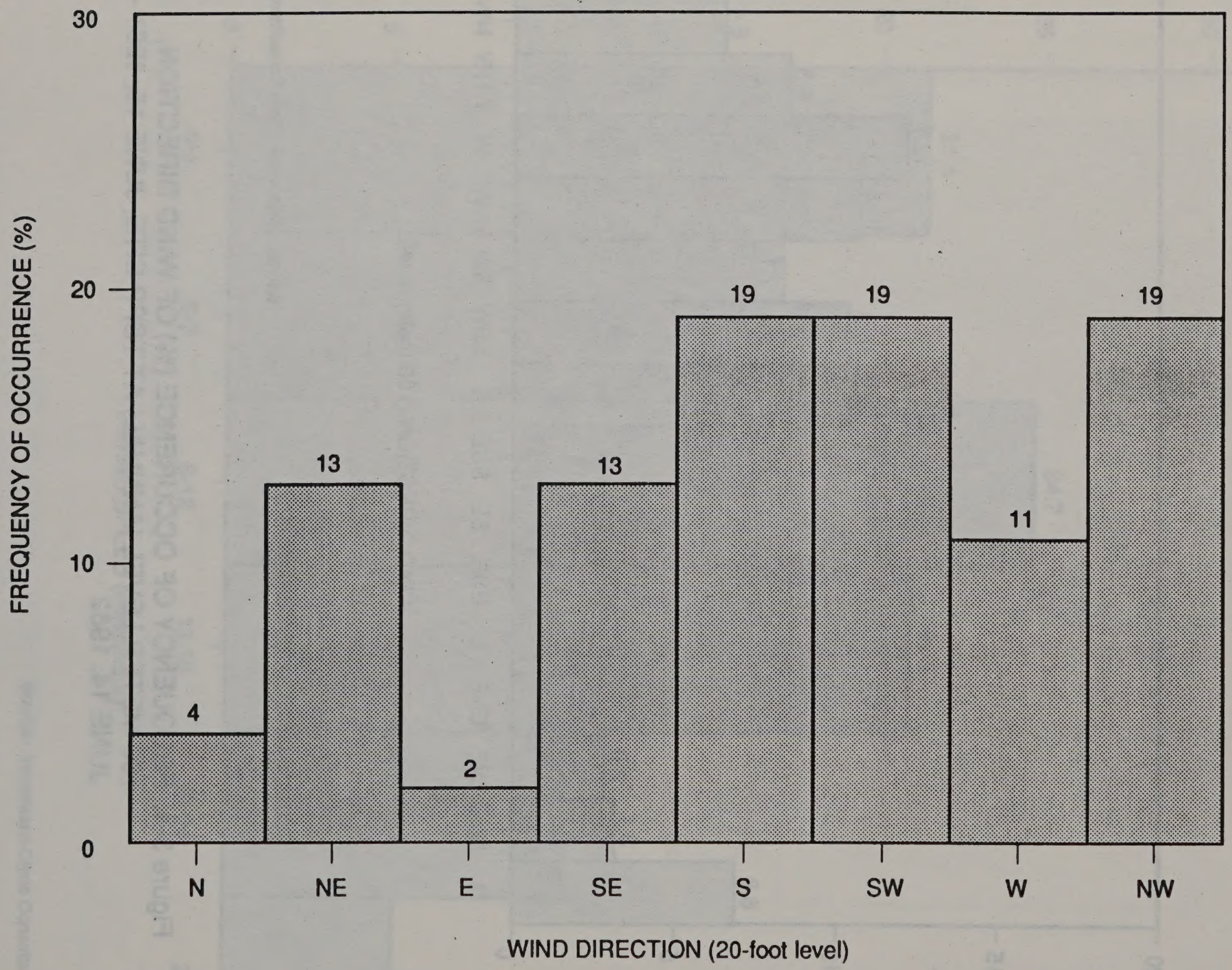
Source: Woodward-Clyde Consultants 1982

Figure 3-3. FREQUENCY OF OCCURRENCE (%) OF WIND SPEED, 100-METER LEVEL (ANNUAL) AT TSPP SITE, JUNE 15, 1981 – JUNE 14, 1982



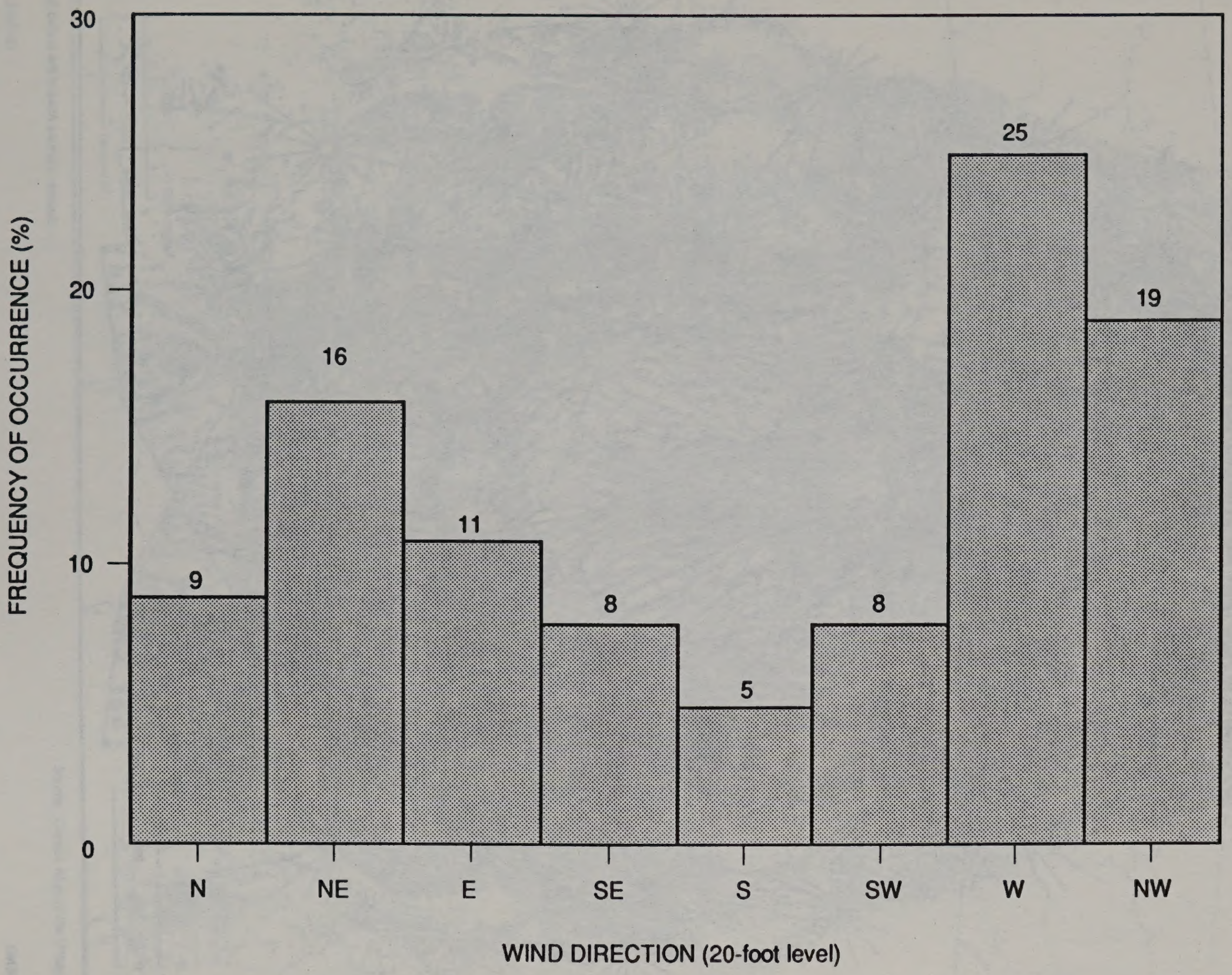
Source: Woodward-Clyde Consultants 1982

Figure 3-4. FREQUENCY OF OCCURENCE (%) OF WIND DIRECTION, 100-METER LEVEL (ANNUAL) AT TSPP SITE, JUNE 15, 1981 – JUNE 14, 1982



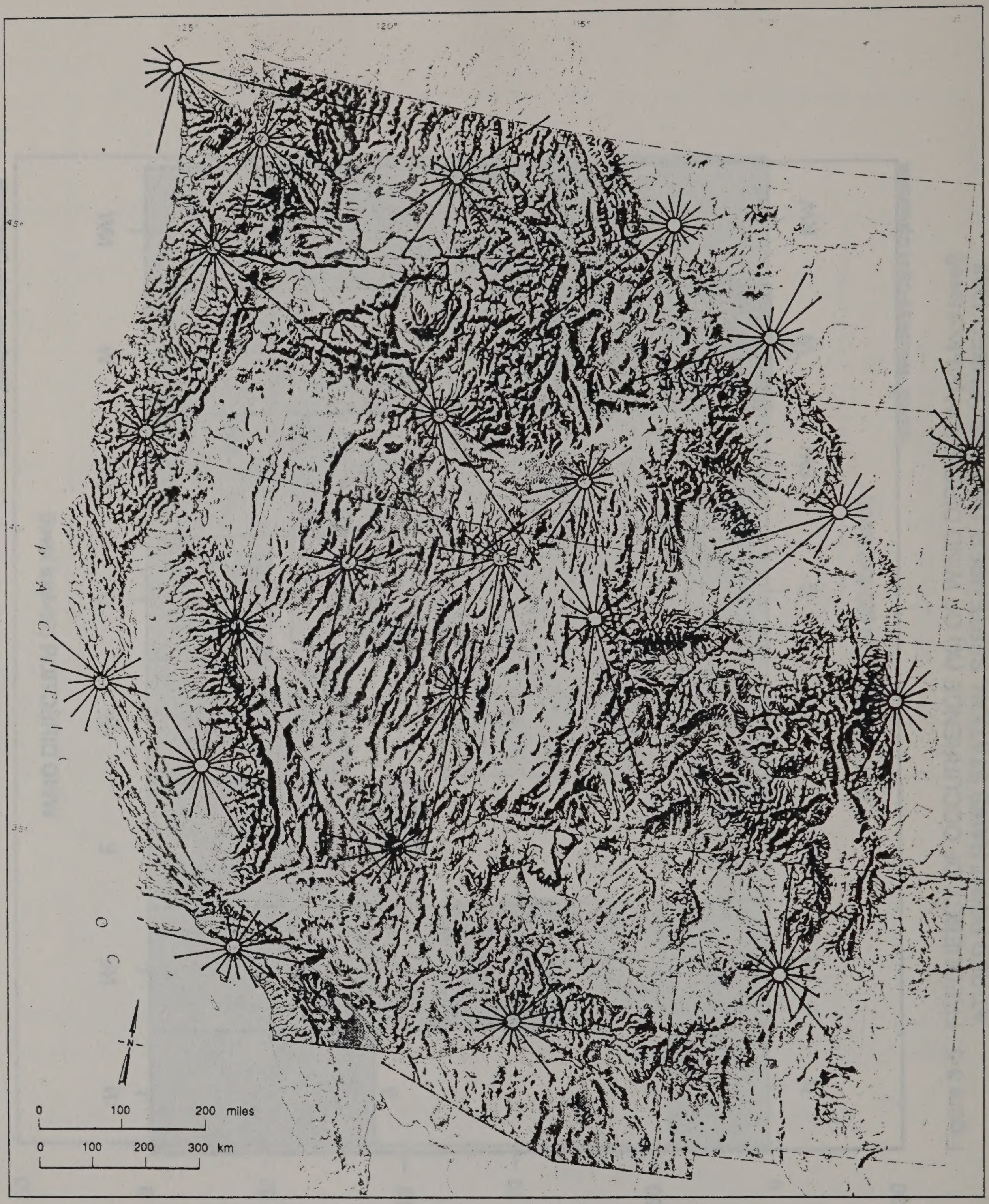
Source: Woodward-Clyde Consultants

Figure 3-5. FREQUENCY OF OCCURRENCE (%) OF WIND DIRECTION (20-foot level) AT RED POINT RAWS STATION, SEPTEMBER 1986 – DECEMBER 1988



Source: Woodward-Clyde Consultants

Figure 3-6. FREQUENCY OF OCCURRENCE (%) OF WIND DIRECTION (20-foot level) AT SPRUCE MOUNTAIN RAWS STATION, SEPTEMBER 1986 – DECEMBER 1988

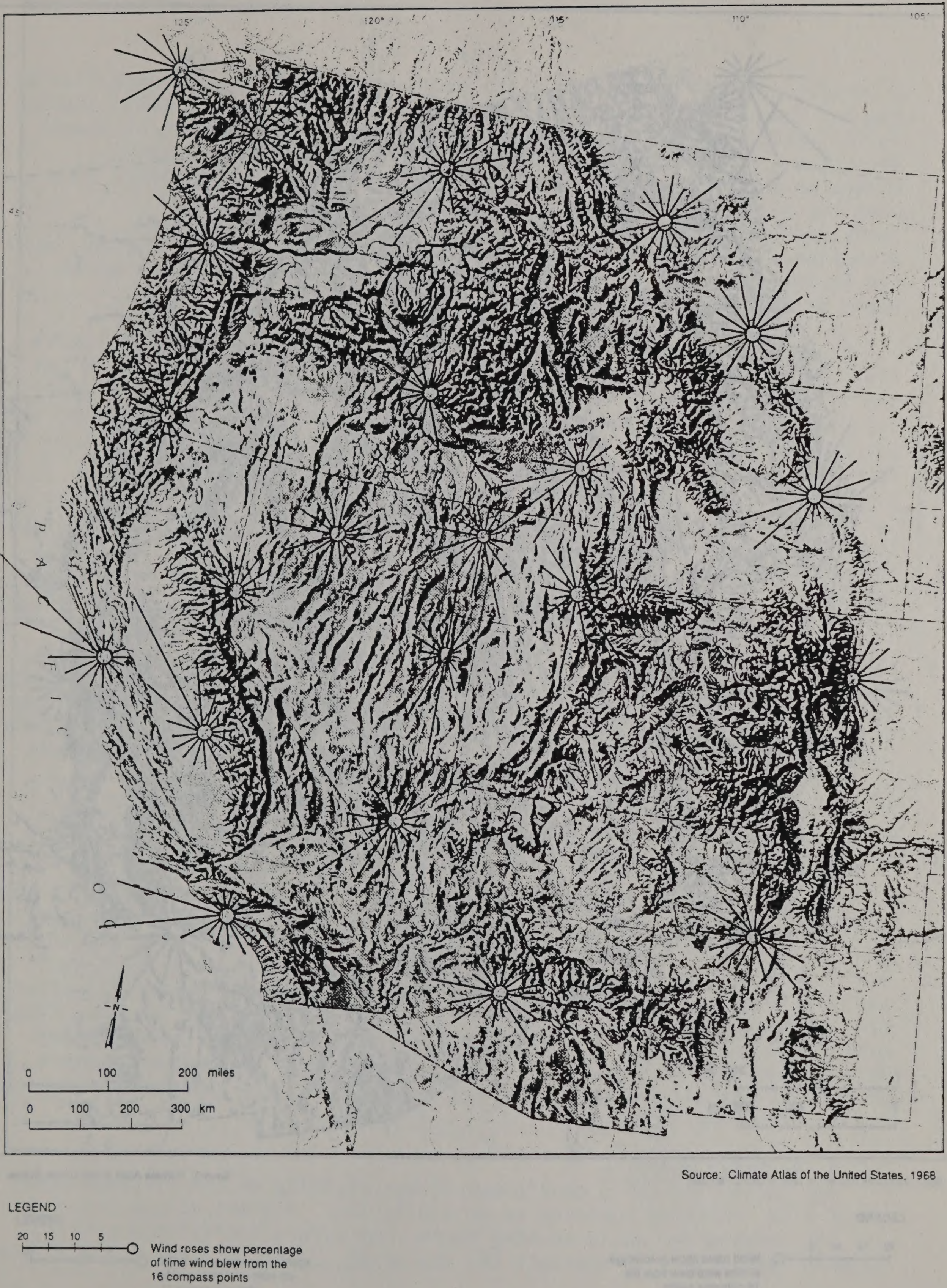


Source: Climate Atlas of the United States, 1968

LEGEND

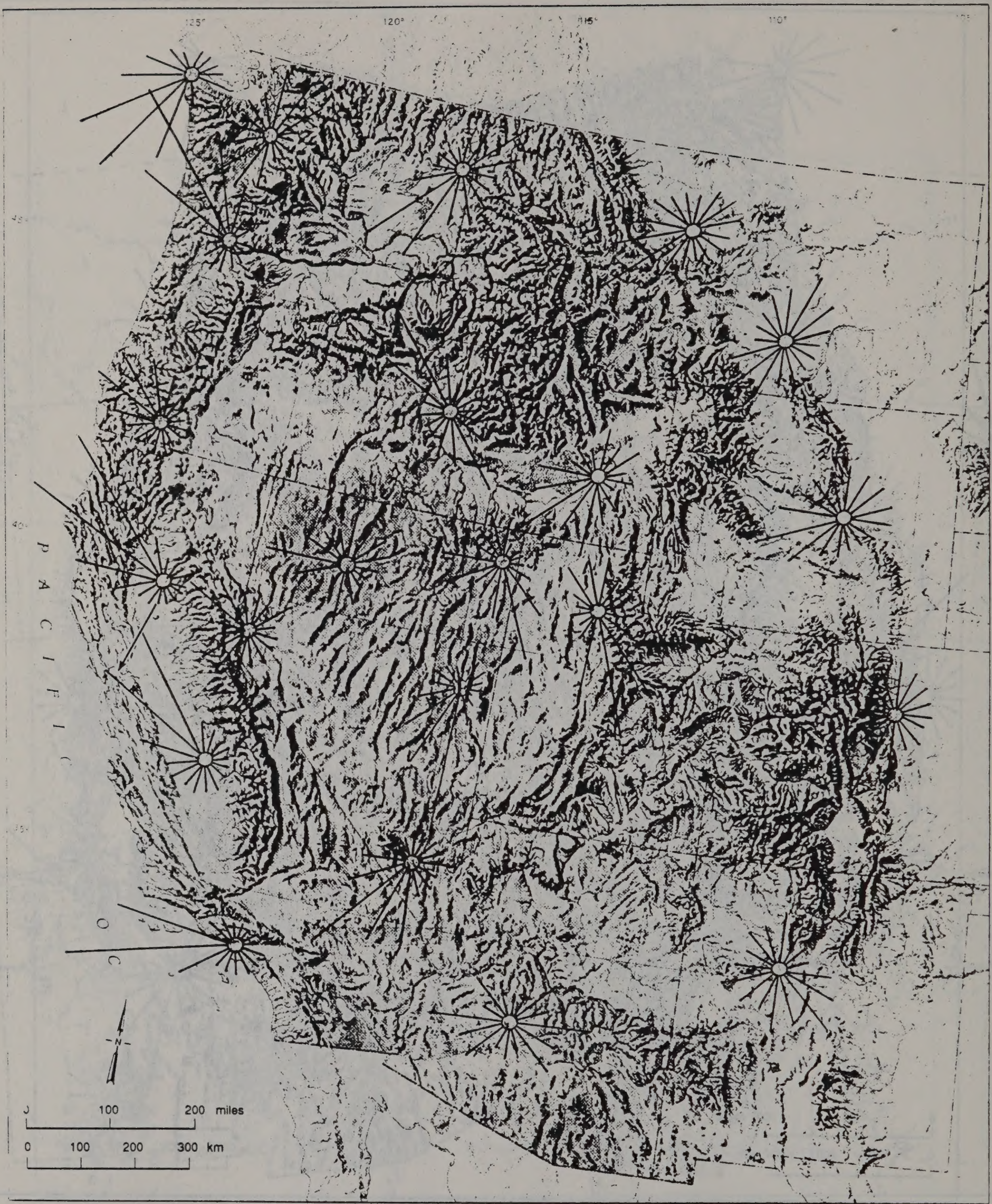
20 15 10 5 Wind roses show percentage of time wind blew from the 16 compass points

Figure 3-7. JANUARY SURFACE WIND ROSES BASED ON HOURLY OBSERVATIONS FROM NATIONAL WEATHER SERVICE STATIONS



Source: Climate Atlas of the United States, 1968

Figure 3-8. APRIL SURFACE WIND ROSES BASED ON HOURLY OBSERVATIONS FROM NATIONAL WEATHER SERVICE STATIONS



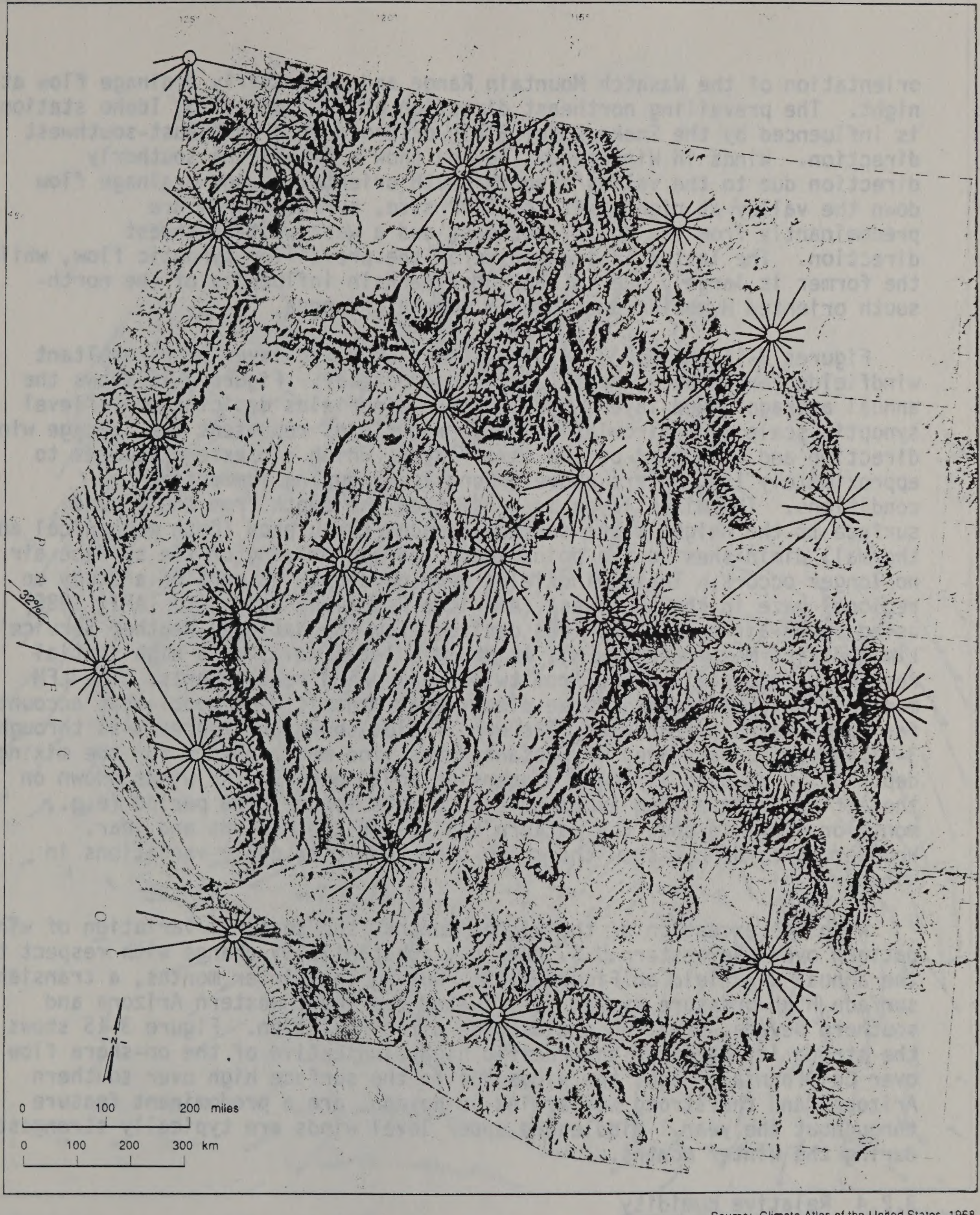
Source: Climate Atlas of the United States, 1968

LEGEND

20 15 10 5

Wind roses show percentage of time wind blew from the 16 compass points

Figure 3-9. JULY SURFACE WIND ROSES BASED ON HOURLY OBSERVATIONS FROM NATIONAL WEATHER SERVICE STATIONS



Source: Climate Atlas of the United States. 1968

LEGEND

20 15 10 5 — Wind roses show percentage of time wind blew from the 16 compass points

Figure 3-10. OCTOBER SURFACE WIND ROSES BASED ON HOURLY OBSERVATIONS FROM NATIONAL WEATHER SERVICE STATIONS

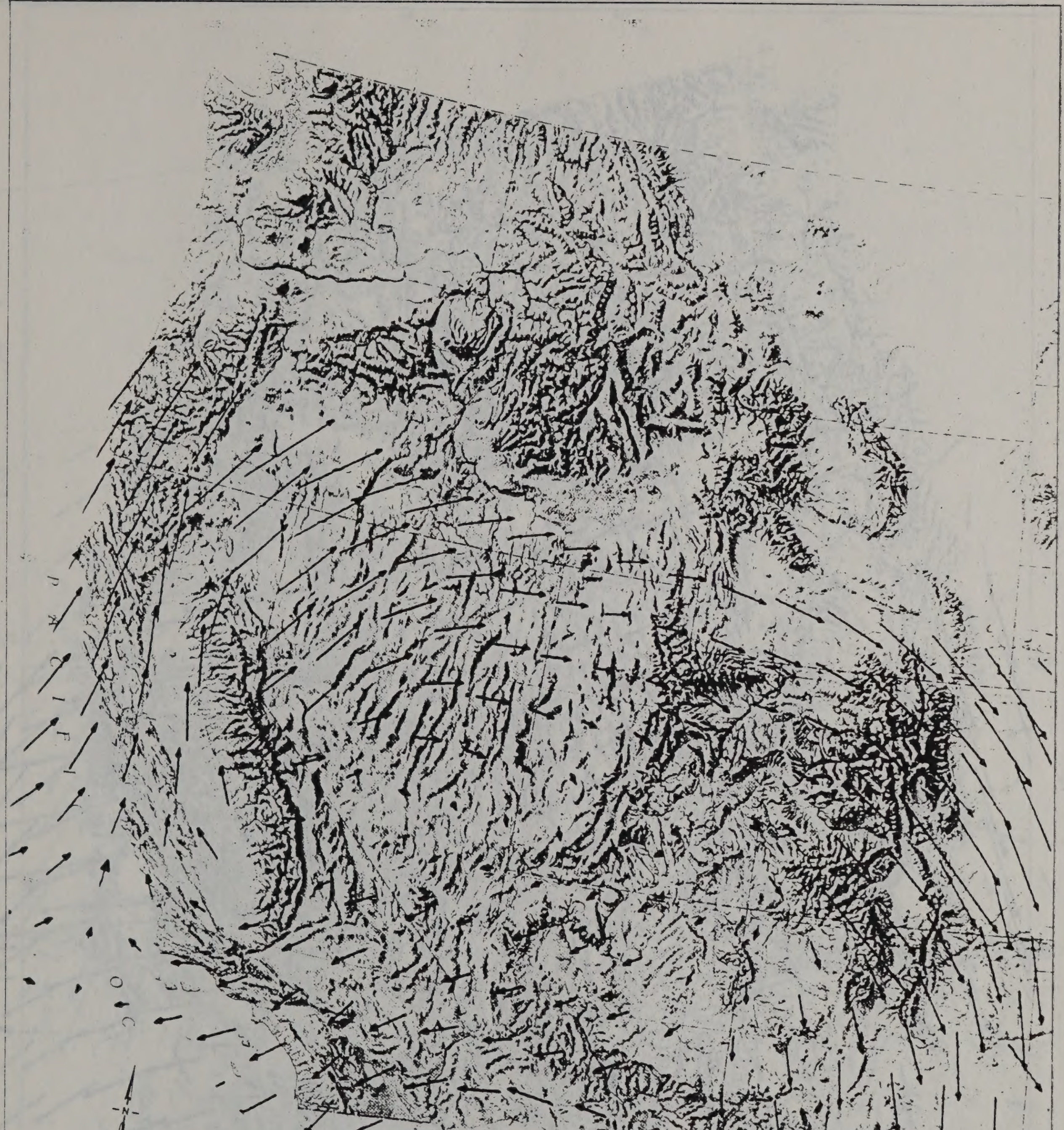
orientation of the Wasatch Mountain Range and a southerly drainage flow at night. The prevailing northeast direction at the Pocatello, Idaho station is influenced by the Snake River Plain oriented in a northeast-southwest direction. Winds in Winnemucca, Nevada show a prevailing southerly direction due to the valley's north-south orientation and drainage flow down the valley at night. At the TSPP site, surface winds are predominantly from the south/southeast and a west/west-southwest direction. The latter is indicative of the prevailing synoptic flow, while the former is largely due to the local terrain influences of the north-south oriented Humboldt and Goshute mountain ranges.

Figures 3-11 through 3-14 show afternoon mixed-layer mean resultant windfields for January, April, July, and October. Figure 3-15 shows the annual average mixed-layer winds. These windfields depict the mid-level synoptic scale wind circulation. The windfields represent the average wind direction and windspeed of the mixed layer, which can extend upwards to approximately 1500 meters above ground level during summertime conditions. The mixed layer is considered the depth from the ground surface to the height where surface-induced turbulence (both mechanical and thermal) diminishes to the point where thorough mixing of the surface air no longer occurs. These windfields were developed as part of a study on regional haze in the southwest (American Petroleum Institute [API] 1985) using upper-air transport winds derived from the National Weather Service's Limited Fine Mesh Model (LFM), which calculates relatively high spatial resolution upper-air winds from twice-daily wind measurements. The LFM model is a sophisticated three-dimensional dynamic wind model that accounts for large terrain features. The wind fields shown on Figures 3-11 through 3-15 are vector averages of instantaneous wind measurements for the mixing depth only, as this is where dispersion would occur. The winds shown on these figures have been averaged over a much longer time period (e.g., month or year) to show the pattern typical of the seasons and year. However, they do not show the short-term hourly or daily variations in winds.

With the exception of the winter months, the seasonal variation of wind pattern over the western U.S. does not substantially change with respect to the annual windfield on Figure 3-15. During the winter months, a transient surface high-pressure system is situated over northwestern Arizona and southern Nevada, creating a clockwise air circulation. Figure 3-15 shows the strong influence of the Pacific high, indicative of the on-shore flow over California. Also, the winds due to the surface high over southern Arizona, and the strong westerlies in Nevada, are a predominant feature throughout the year. Middle and upper level winds are typically strongest during the winter months.

3.2.4 Relative Humidity

Due to the semi-arid conditions in the vicinity of the proposed power plant site, relative humidity is generally low. Highest values occur during the evening and early morning hours when strong radiational cooling enables temperature to approach the dew point. High relative humidity also



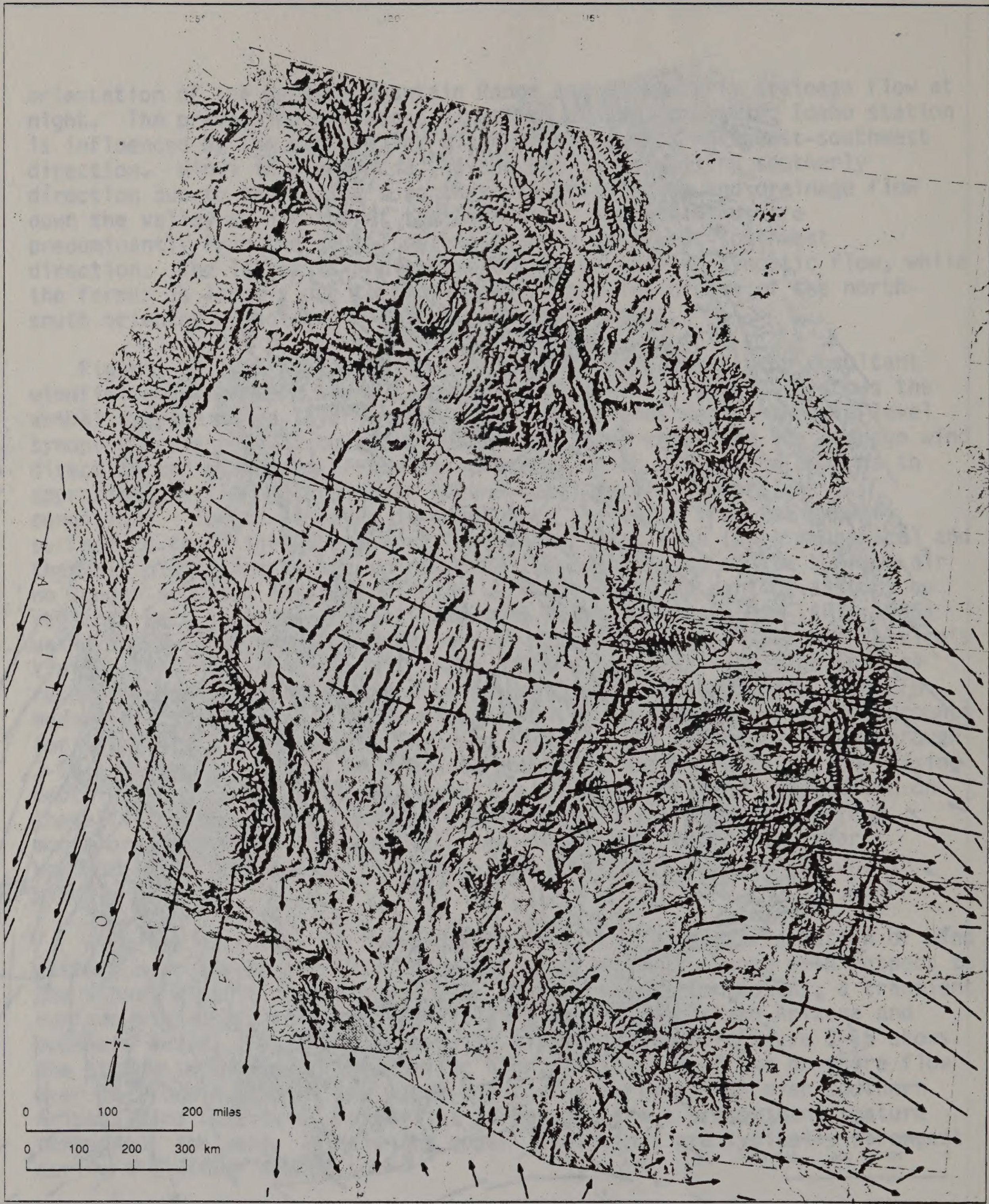
Source: API 1985

LEGEND

0 5
meter/sec

Wind direction denoted by arrow.
Wind speed (m/sec) denoted by length of arrow.

Figure 3-11. JANUARY AFTERNOON MIXED-LAYER MEAN RESULTANT LFM WIND FIELD IN 1981

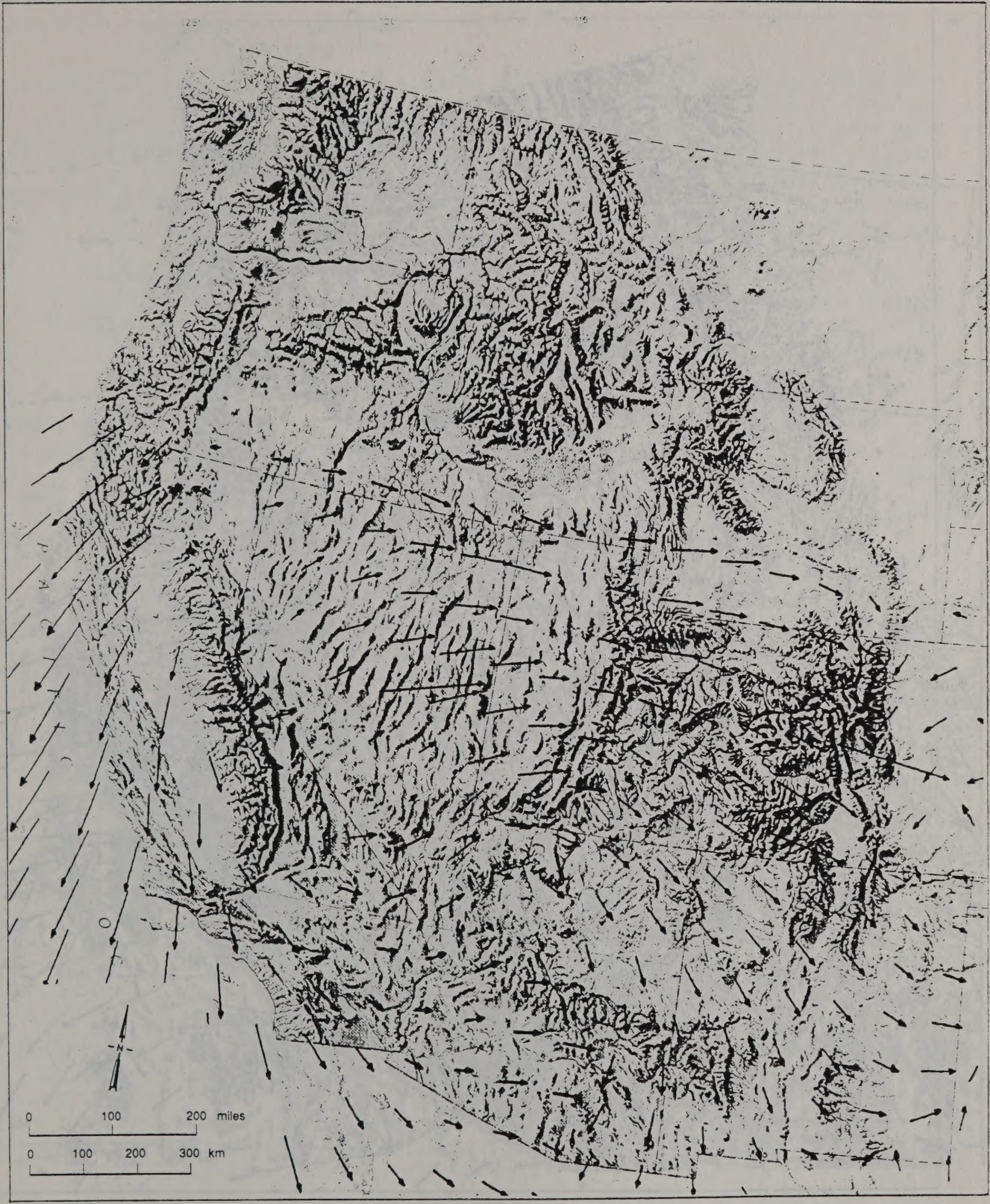


Source: API 1985

LEGEND

Wind direction denoted by arrow.
Wind speed (m/sec) denoted by length of arrow.

Figure 3-12. APRIL AFTERNOON MIXED-LAYER MEAN RESULTANT LFM WIND FIELD IN 1981



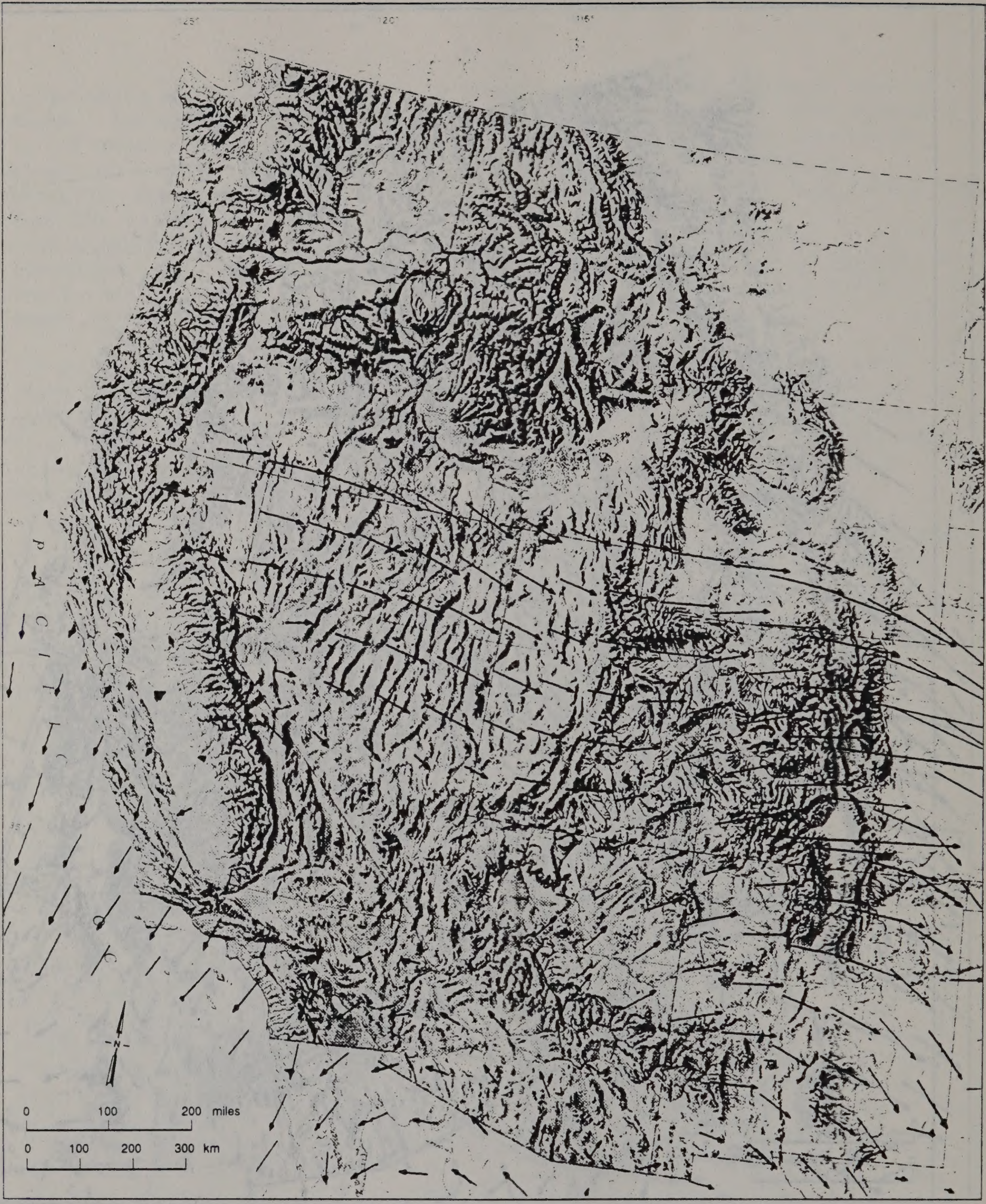
Source: API 1985

LEGEND

0 5
meter/sec

Wind direction denoted by arrow.
Wind speed (m/sec) denoted by length of arrow.

Figure 3-13. JULY AFTERNOON MIXED-LAYER MEAN RESULTANT LFM WIND FIELD IN 1981



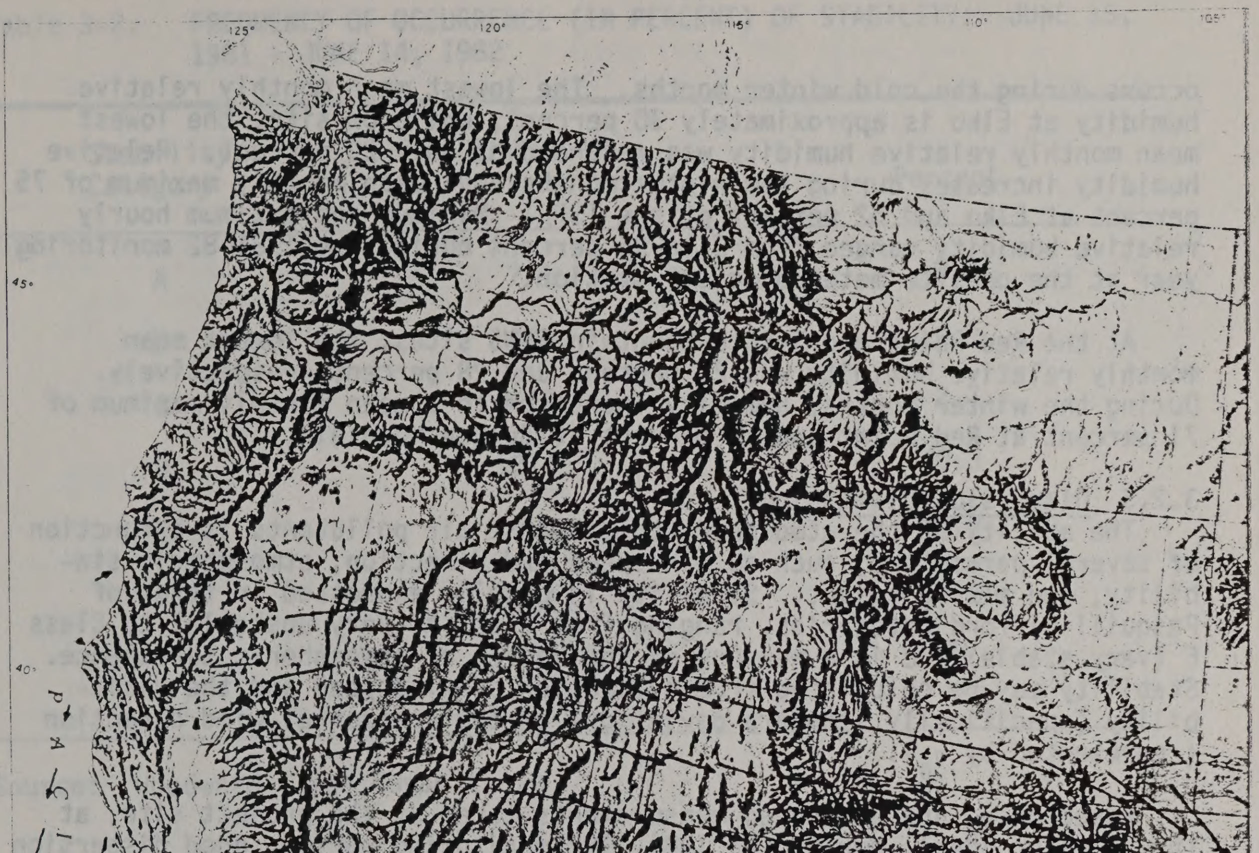
Source: API 1985

LEGEND

0 5
meter/sec

Wind direction denoted by arrow.
Wind speed (m/sec) denoted by length of arrow.

Figure 3-14. OCTOBER AFTERNOON MIXED-LAYER MEAN RESULTANT LFM WIND FIELD IN 1981



Source: API 1985

LEGEND

0 5 meter/sec Wind direction denoted by arrow.
Wind speed (m/sec) denoted by length of arrow.

Figure 3-15. ANNUAL AFTERNOON MIXED-LAYER MEAN RESULTANT LFM WIND FIELD IN 1981

occurs during the cold winter months. The lowest mean monthly relative humidity at Elko is approximately 30 percent, while on site, the lowest mean monthly relative humidity was recorded at only 20 percent. Relative humidity increases during the winter months to a mean monthly maximum of 75 percent at Elko and 62 percent at the TSPP. Minimum and maximum hourly relative humidity ranged from 2 to 95 percent during the 1981-82 monitoring year at the on-site meteorological station.

At the Red Point and Spruce Mountain RAWS sites, the lowest mean monthly relative humidity was 27 percent and 28 percent, respectively. During the winter months, humidity increased to a mean monthly maximum of 71 percent at Red Point and 66 percent at Spruce Mountain.

3.2.5 Dispersion Climatology

The ability of the atmosphere to disperse air pollutants is a function of several parameters, such as windspeed and direction, atmospheric stability, and mixing height. Stability is usually expressed in terms of Pasquill-Gifford Categories, ranging from Class A (very unstable) to Class F (very stable) and is a measure of the degree of atmospheric turbulence. Stability may be calculated from evaluation of windspeed and the variability (specifically standard deviation) of the horizontal wind direction (represented by σ_θ).

Based on σ_θ and windspeed measurements taken at the project site, at the 10-meter level, during the 1981-1982 monitoring period, good dispersion conditions (Classes A through D) occurred 63 percent of the time. Poor dispersion conditions (Classes E and F) occurred 37 percent of the time. Table 3-2 lists the frequency of occurrence of each stability class.

Mixing height provides an indication of the potential vertical extent of pollutant diffusion. It is a measure of the thickness of the layer of the lower atmosphere in which pollutants may freely disperse. As is typical of desert-like environments, the mixing-height in the project area can be quite high during the afternoon due to strong convective activity which mixes the air vertically throughout the lower levels of the atmosphere. Conversely, mixing heights can be quite low in the morning because of nighttime radiational cooling, which causes surface-based or low-level inversions to form. The annual average morning mixing height during the 1981-1982 period at Elko was approximately 200 meters (700 feet) and the annual average afternoon mixing height was approximately 2300 meters (7500 feet).

Inversions occur when air temperature increases with height through a layer of the atmosphere. Within an inversion layer the air is said to be stable. That is, very little mixing occurs, and any pollutants emitted into the inversion layer are not readily dispersed.

Although inversions can occur as a result of a variety of different atmospheric and meteorological conditions, the majority of the inversions that occur in the project area are a result of nighttime radiative cooling

Table 3-2. FREQUENCY OF OCCURRENCE (IN PERCENT) OF STABILITY: JUNE 15, 1981 - JUNE 14, 1982

Stability Category	Number of Observations	Percent
A	771	9.7
B	389	4.9
C	615	7.7
D	3214	40.3
E	1429	17.9
F	1512	19.6
	7983	100

Source: Woodward-Clyde Consultants

of the earth's surface and associated cooling of the lower layer of the atmosphere. Ideal conditions for radiational cooling, clear calm nights with low humidity levels, can occur frequently in the project area.

For the EPA, the National Climatic Center (NCC) performed a study of inversion frequency using 5 years of data (January 1960 - December 1964) for Winnemucca and Ely, Nevada (NCC 1973). Results of this study for both Winnemucca and Ely are summarized in Table 3-3. Although both data sets are presented, the data for Ely are believed to be more representative of the conditions at the site, due to similarities in topography and elevation. As might be expected, the data show that inversions occur more frequently during the winter months.

On an annual basis, the frequency of occurrence of all types of inversions was 61 percent at Ely. It is important to note that this 61 percent frequency of occurrence for all inversion types is an average of measurements taken twice a day, during pre-dawn and late afternoon hours. The data indicates that the greatest majority of inversions occur at night, or during the pre-dawn hours. Pre-dawn observations show that 94 percent of the time inversions exist. Because the majority of these inversions are formed at night by radiative cooling, they dissipate rapidly after sunrise. This is supported by the greatly reduced number of inversions existing during the late afternoon hours (28 percent of all inversions). Thus, while most of the time inversions are present in the morning, only 28 percent persisted throughout the day, or were newly formed. Low-level inversions, defined as inversions with their base between ground level and 100 meters above ground level, occurred 50 percent of the time. For low-level inversions, late afternoon inversions only occurred 7.4 percent of the time. Shallow low-level inversions, defined as being ground-based inversions and with their tops at or below 100 meters above ground level, occurred 5 percent of the time on an annual basis and 11 percent of the time during the winter. Shallow low-level inversions in the late afternoon occurred about 2 percent of the time.

3.2.6 Severe Weather

The occurrence of severe weather conditions in the vicinity of the TSPP site is infrequent and of short duration. During the period from 1955 to 1967, only eight tornadoes were reported in the entire state of Nevada (Thom 1968). From Elko climatological data, the average number of days per year with thunderstorms is less than 21, occurring primarily during the warmer months of May through September. Occasionally, "dust devils" may form during mid-summer afternoons in the presence of strong daytime heating.

The average number of days per year with snowfalls of 1-inch accumulation or more is only 14. Average total snowfall for the year is 38.2 inches. The number of months at Elko in which total monthly snowfall exceeded 20 inches was only 3 during the climatological period of 1956-86.

Table 3-3. FREQUENCY OF OCCURRENCE (IN PERCENT) OF ALL INVERSIONS, LOW-LEVEL INVERSIONS, AND SHALLOW LOW-LEVEL INVERSIONS

	Ely	Winnemucca
All Inversions		
Winter	75	78
Spring	54	56
Summer	53	52
Fall	62	67
Annual	61	63
Low-Level Inversions[1]		
Winter	55	46
Spring	45	41
Summer	50	47
Fall	48	47
Annual	50	45
Shallow Low-Level Inversions[2]		
Winter	11	6
Spring	7	10
Summer	0	9
Fall	3	6
Annual	5	8

Source: NCC 1973

[1] Low-Level Inversions - Base between 0 and 100 meters above ground level and thickness of between 1 and 1500 meters.

[2] Shallow Low-Level Inversions - Base at ground level with top at or below 100 meters.

3.3 AIR QUALITY RELATED VALUES

The following air quality related values (AQRVs) have been identified by the U.S. Forest Service (USFS) as having value related to the quality of air:

- Flora
- Fauna
- Soil
- Water
- Odor
- Visibility
- Cultural and archaeological resources

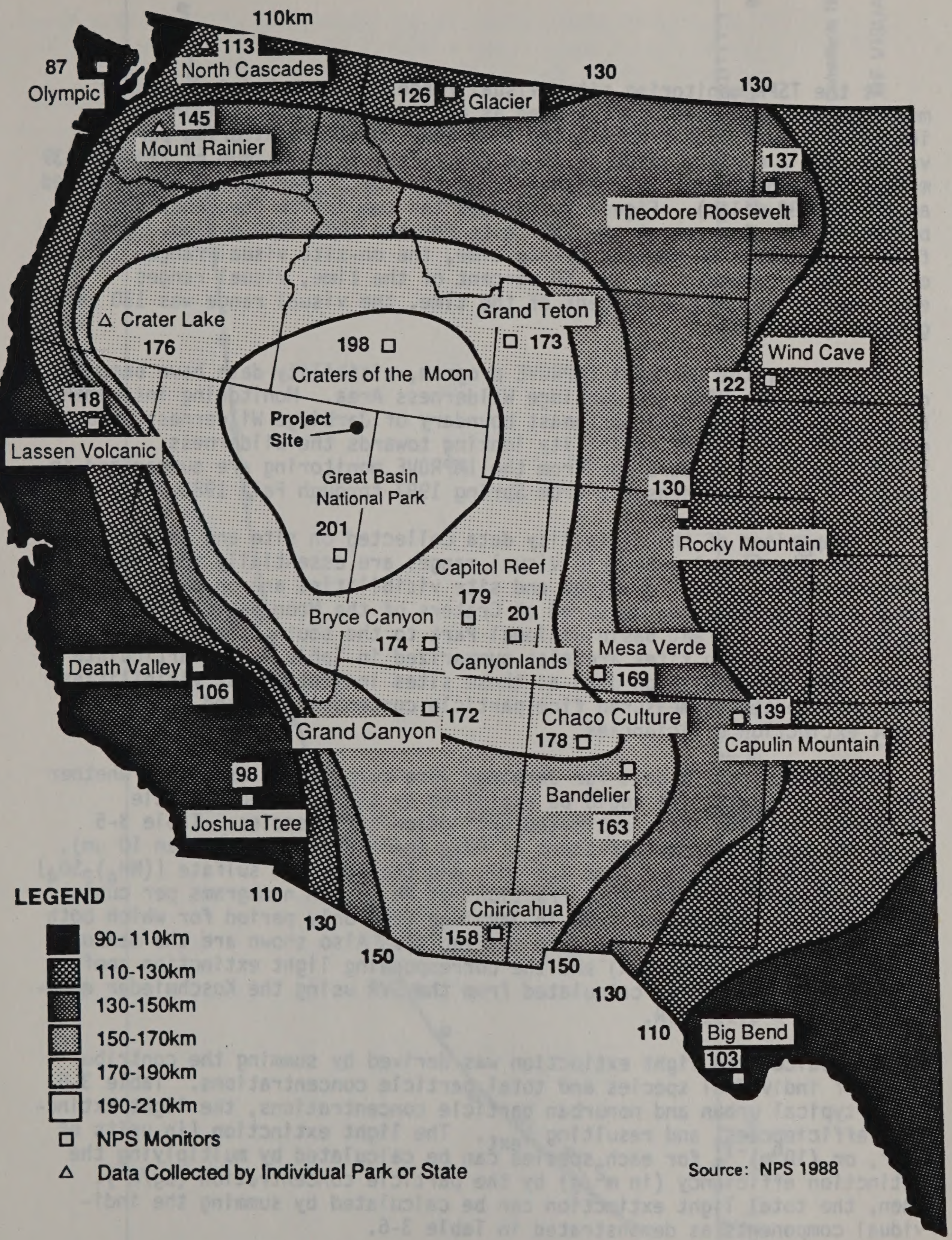
As there is potential for the proposed project to impact these resources, it is important to establish their existing condition so that potential changes resulting from the project may be evaluated. For the proposed TSPP project, the USFS has identified sensitive receptors and limits of acceptable change (LAC) for the following AQRVs: water, flora, fauna, and visibility (USFS 1989a).

The AQRV and its associated sensitive receptor identified by the USFS are listed in Table 2-3. Sensitive receptors and LAC for the other AQRVs have not been specified by the USFS for this project. Consequently, rather than reiterate information regarding the existing conditions of these resources discussed elsewhere in other Technical Reports and the EIS, the following sections focus on, and discuss the existing visibility, precipitation chemistry (i.e., "acid rain", or more correctly, acid deposition) of the region, and how they relate to the sensitive receptors.

3.3.1 Visibility

Due to very low ambient concentrations of fine particles and the dry nature of the area surrounding the proposed power plant site, visibility is extremely good. A common measure of visibility is the standard visual range, which is the distance from an observer at which a black object just disappears against the horizon. Visibility conditions are monitored by the National Park Service (NPS) and the Interagency Monitoring of Protected Visual Environments (IMPROVE) program at numerous locations throughout the country. Most of the visibility monitoring sites are Class I areas, which the Clean Air Act Amendments of 1977 singled out for special visibility protection. Some other sites were included in response to a particular visibility problem, or because visual air quality was a especially important value at those parks, or because they were situated along an important pollution pathway (NPS 1988).

Figure 3-16 shows the median standard visual range for the western U.S. for June through August 1983. The median value means that 50 percent of the time the visual range is at this level or greater. Figure 3-16 indicates that the area with the best visibility is in Nevada, Utah, and Idaho, with a median summer visual range between 190 and 210 kilometers (km).



Source: NPS 1988

Figure 3-16. ISOPLETHS OF MEDIAN VISUAL RANGE OVER THE WESTERN UNITED STATES, SUMMER 1983

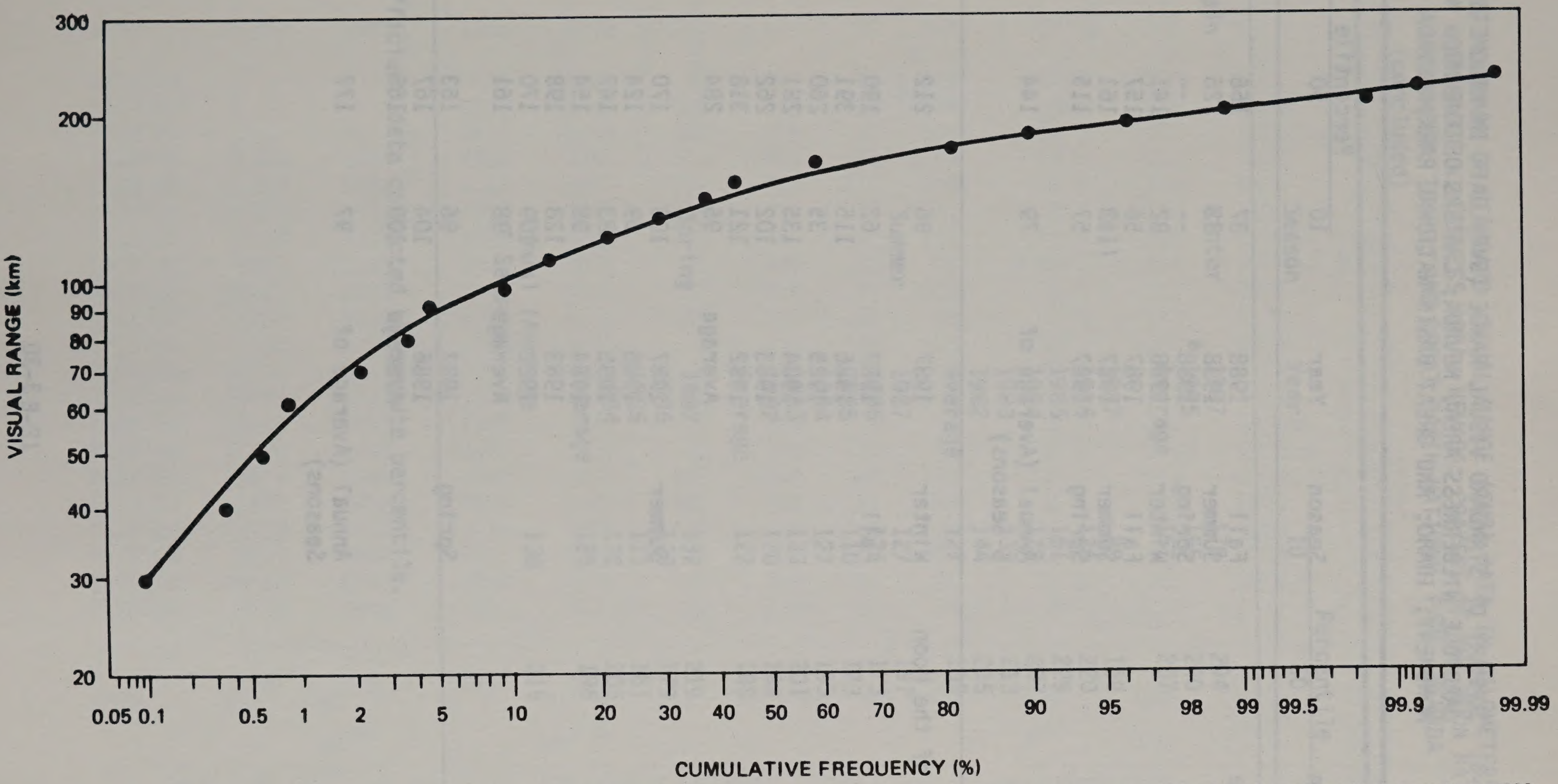
At the TSPP monitoring site, visual range, as computed from hourly measurements of B-scat, can be used as an indicator of prevailing visibility. Visual ranges during the 1981-1982 on-site monitoring period varied from a minimum value of 16 km (10 miles) to a maximum of 224 km (139 miles). The geometric mean visual range for the 1-year period was computed as 142 km (88 miles). Figure 3-17 shows the cumulative frequency distribution of visual range at the TSPP site for the 1981-1982 period. This figure shows that 90 percent of the time, the on-site visual range observations exceeded 100 km; 50 percent of the time, visual ranges exceeded 150 km; and 10 percent of the time, the visual range was 180 km or greater (WCC 1982).

As part of the national IMPROVE program, visibility data have been collected by the USFS for Jarbidge Wilderness Area. Monitoring instruments have been located on the northeast boundary of Jarbidge Wilderness Area to obtain measurements of visibility looking towards the wilderness. Visibility data for Jarbidge from the IMPROVE monitoring are summarized in Table 3-4 for seven seasons, from Spring 1987 through Fall 1988.

A comparison of the visibility data collected on site and at Jarbidge show that the annual geometric visual ranges are essentially the same, approximately 140 km. Jarbidge and site visibilities are on the average lower than visibilities measured at Craters of the Moon National Monument to the north and Great Basin National Park to the south. The visibilities at these latter two sites are also summarized in Table 3-4. Particulate matter (PM) concentration data at these sites indicates that visibilities are consistent with measured fine particle concentrations and published light extinction efficiencies.

Visibility and PM data for Jarbidge were compared to ascertain whether the measured visibility could be explained by the measured particle concentrations and their estimated extinction efficiencies. Table 3-5 shows the measured concentrations of PM_{10} (particles smaller than 10 μm), $PM_{2.5}$ (particles smaller than 2.5 μm), and the ammonium sulfate $[(NH_4)_2SO_4]$ and ammonium nitrate (NH_4NO_3) fractions of $PM_{2.5}$, in nanograms per cubic meter (ng/m^3), for Summer 1988 in Jarbidge (the only period for which both particle and visibility data were available). Also shown are the measured standard visual range (SVR) and the corresponding light extinction coefficient (b_{ext}) which is calculated from the SVR using the Koschmieder equation: $b_{ext} = 3.912/SVR$.

The calculated light extinction was derived by summing the contributions of individual species and total particle concentrations. Table 3-6 shows typical urban and nonurban particle concentrations, the light extinction efficiencies, and resulting b_{ext}. The light extinction [in units of Mm^{-1}, or $(10^6 m)^{-1}$] for each species can be calculated by multiplying the extinction efficiency (in m^2/g) by the particle concentration ($\mu g/m^3$). Then, the total light extinction can be calculated by summing the individual components as demonstrated in Table 3-6.



Source: Woodward-Clyde Consultants 1982

Figure 3-17. LOG PROBABILITY CUMULATIVE FREQUENCY DISTRIBUTION OF VISUAL RANGE (Annual) AT TSPP SITE, JUNE 15, 1981 – JUNE 14, 1982

Table 3-4. SUMMARY OF STANDARD VISUAL RANGE (SVR) DATA IN KILOMETERS AT JARBIDGE WILDERNESS AREA, NEVADA; CRATERS OF THE MOON NATIONAL MONUMENT, IDAHO; AND GREAT BASIN NATIONAL PARK, NEVADA

			Percentile		
Location	Season	Year	10	50	90
Jarbidge	Fall	1988	87	166	270
	Summer	1988	82	126	186
	Spring	1988[a]	--	--	--
	Winter	1988	82	141	226
	Fall	1987	56	157	283
	Summer	1987	112	161	247
	Spring	1987	57	115	240
	Annual (Average of 6 Seasons)		79	144	242
Craters of the Moon	Winter	1987	96	212	359
	Fall	1987	62	190	190
		1986	115	391	391
		1985	35	260	260
		1984	135	281	281
		1983	102	262	262
		1982	121	318	318
		Average	95	284	284
	Summer	1987	103	170	258
		1986	69	124	222
		1985	83	147	237
		1984	98	154	242
		1983	128	198	305
		1982	109	170	265
		Average	98	161	240
	Spring	1987	96	163	258
		1986	104	167	270
		Average	100	165	264
	Annual (Average of Seasons)		97	177	287

Table 3-4. SUMMARY OF STANDARD VISUAL RANGE (SVR) DATA IN KILOMETERS AT JARBIDGE WILDERNESS AREA, NEVADA; CRATERS OF THE MOON NATIONAL MONUMENT, IDAHO; AND GREAT BASIN NATIONAL PARK, NEVADA (concluded)

Location	Season	Year	Percentile 10	 50	 90
Great Basin	Winter	1987	179	294	391
		1985	155	240	371
		Average	167	267	381
	Fall	1987	80	168	271
		1986	126	220	354
		1985	151	229	347
		1984	128	207	336
		1983	133	213	340
		1982	144	215	322
		Average	127	209	328
	Summer	1987	127	197	303
		1986	121	173	249
		1985	110	173	272
		1984	127	193	292
		1983	133	201	302
		1982	120	188	293
		Average	123	188	285
	Spring	1987	137	219	350
		1986	110	179	292
		1985	121	181	270
		1984	132	205	319
		Average	125	196	308
	Annual (Average of Seasons)		136	215	326

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[a] Insufficient data collected to compute percentile.

Table 3-5. JARBIDGE WILDERNESS AREA PARTICULATE AND VISIBILITY DATA FOR SUMMER 1988: COMPARISON OF MEASURED B_{ext} AND B_{ext} CALCULATED FROM PARTICLE CONCENTRATIONS

	Measured PM_{10} and $PM_{2.5}$ in Jarbidge Wilderness (ng/m^3)								Calculated Visibility		Measured Visibility	
Date	PM_{10}	PM_{10}- $PM_{2.5}$	$PM_{2.5}$	$PM_{2.5}$- SO_4-NO_3	S	$(NH_4)_2SO_4$	NO^3	NH_4NO_3	B_{ext} (Mm^{-1})	SVR (km)	B_{ext} (Mm^{-1})	SVR (km)
6/08/88	5436	3846	1590	1247	65	268	58	74	18.7	210	12.6	310
6/11/88	10783	8185	2598	2198	76	314	67	87	23.5	167	26.1	150
6/15/88	9631	6208	3423	2659	156	644	93	120	25.5	153	43.5	90
6/18/88	11376	7758	3618	2482	236	974	126	163	27.1	144	39.9	98
6/22/88	5839	3309	2530	1707	191	788	27	35	21.7	180	25.2	155
6/25/88	13914	8545	5369	3832	343	1415	95	122	33.1	118	46.0	85
6/29/88	10530	6566	3964	3586	82	338	31	40	26.9	145	25.2	155
7/02/88	21419	15870	5549	5312	46	190	37	47	35.2	111	29.0	135
7/06/88	19662	13987	5675	5343	62	256	59	76	35.0	112	26.1	150
7/09/88	13142	8475	4667	4417	45	186	50	64	29.6	132	35.6	110
7/13/88	8339	4345	3994	3573	71	293	99	128	26.1	150	26.1	150
7/16/88	13593	9209	4384	3776	126	520	69	88	29.4	133	27.0	145
7/20/88	10161	5884	4277	3795	91	375	83	106	27.7	141	30.1	130
7/23/88	16809	11392	5417	5016	83	342	46	59	33.2	118	32.6	120
7/27/88	8770	4404	4366	3664	145	598	80	104	27.6	142	31.3	125
7/30/88	14125	9169	4956	4396	116	479	63	81	31.1	126	32.6	120
8/03/88	11395	7268	4127	3423	136	561	111	143	28.0	140	24.5	160
8/06/88	11458	7089	4369	3761	107	441	129	167	28.6	137	19.6	200
8/10/88			3824	3199	125	516	85	109	24.1	162	19.6	200
8/13/88			6626	5760	152	627	185	239	32.7	119	36.6	107
8/17/88			3289	2788	96	396	82	105	22.4	175	23.7	165
Mean	12021	7862	4220	3616	121	501	80	103	28.0	144	29.2	146

Source: Latimer 1989a.

Table 3-6. "TYPICAL" URBAN AND NONURBAN PARTICLE CONCENTRATIONS AND LIGHT EXTINCTION

		Urban		Nonurban	
	Extinction-to-mass (m^2/g)	Mass Concentration $(\mu g/m^3)$	b_{ext} (Mm^{-1})	Mass Concentration $(\mu g/m^3)$	b_{ext} (Mm^{-1})
Blue-sky Rayleigh scatter	--	--	10	--	10
Fine particles (<2.5 µm)					
SO_4 (+ H_2O)	4-8	7	28	1	4
NO_3 (+ H_2O)	4-8	3	12	0	0
Elemental carbon	13	5	65	0.1	1.3
Primary organic carbon	3	9	27	0.2	0.6
Secondary organic carbon	3	2	6	1	3
Other	3	6	18	0.1	0.3
Subtotal		32	156	2.4	9.2
Coarse particles (PM_{10})					
Soil dust	0.4	3	1.2	3	1.2
Anthropogenic	0.4	9	3.6	3	1.2
Subtotal		12	4.8	6	2.4
Other TSP (> 10 µm)	<0.04	56	2	20	0.8
Nitrogen dioxide gas (NO_2)	0.17	100	17	1	0.2
Total particle concentration or extinction		100	189.8	28.4	22.6
Corresponding visual range					
Kilometers			21		173
Miles			13		107

Source: Latimer et al. 1985

Table 3-5 shows the b_{ext} calculated in this manner from the measured particle concentrations. The light extinction efficiencies for sulfate and nitrate were assumed to be 4 m^2/g. The light extinction efficiencies for the remainder of $PM_{2.5}$ and PM_{10} were assumed to be 3 and 0.4 m^2/g, respectively. In addition, light absorption due to elemental carbon (not measured specifically) was assumed to be 1 Mm^{-1}. Natural blue-sky Rayleigh scattering (due to scattering from air molecules) was assumed to be 10 Mm^{-1}.

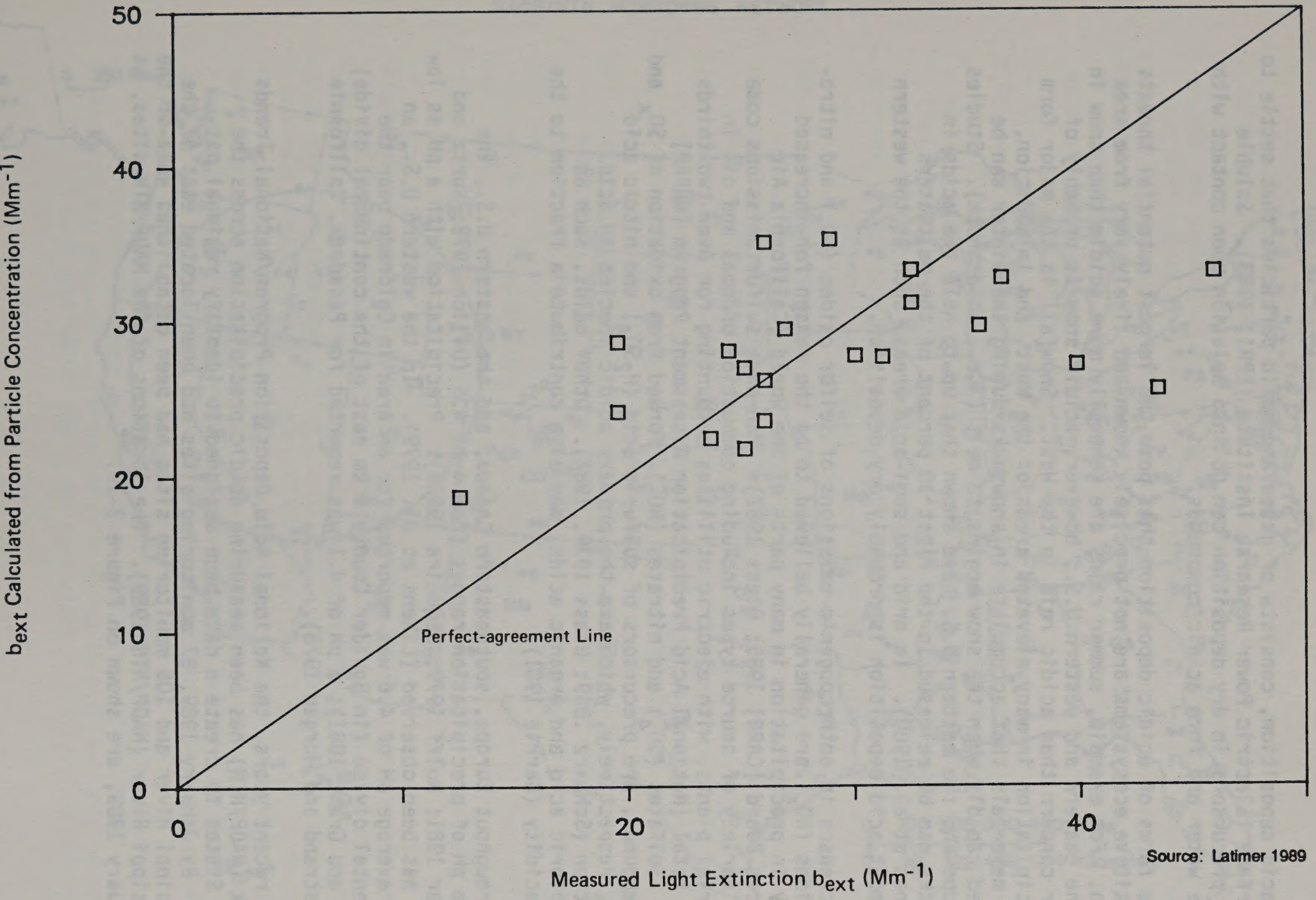
Figure 3-18 shows a scatter plot of calculated versus measured light extinction. Although the overall average light extinction is estimated quite well from particle concentrations, the variance in the calculated light extinction is less than the measured. This can be explained by the assumption that elemental carbon, total suspended particulate matter (TSP) > 10 µm , and nitrogen dioxide (NO_2) concentrations did not vary with time. Also, the assumption that the sulfate and nitrate light scattering efficiency was a constant did not capture the likely variation in this efficiency with relative humidity. Sulfate and nitrate are hygroscopic and their scattering efficiencies are known to increase with increased particle water content at higher humidities.

On average, the scattering and absorption due to fine particles account for most of the light extinction (50.7 percent). The contributions from the coarse portion of PM_{10} and the portion of TSP greater than 10 µm average 9.6 and 3.6 percent, respectively. The remainder of the light extinction is due to natural Rayleigh scattering (35.7 percent).

3.3.2 Acid Precipitation

The phenomena of acid deposition, has undergone considerable study over the past decade due to concern about potential damage to aquatic and terrestrial ecosystems. In the absence of anthropogenic influences (i.e., human-caused air emissions), normal precipitation is slightly acidic due to interaction with atmospheric carbon dioxide, as well as with naturally occurring nitrogen and sulfur oxides (Robinson 1984). Precipitation can also be alkaline in areas where basic components, particularly calcium ions, occur. Acidity is measured by pH, a logarithmic scale from 0 to 14 representing the concentration of hydrogen ions (H^+) in solution. A difference of one pH unit represents a tenfold change in hydrogen ion concentration. Solutions having a pH below 7.0 are considered acidic, while those with a pH above 7.0 are considered alkaline or basic, and a pH of 7.0 is considered neutral. The pH of normal precipitation is approximately 5.6 (National Commission on Air Quality 1981).

Acid deposition may occur in either wet (rain, snow, fog) or dry (gases, particles) forms. Wet deposition ("acid precipitation") introduces acidic compounds directly to the earth's surface. The term "acid precipitation" applies to areas which receive precipitation with a pH less than 5.6 (National Commission on Air Quality 1981). On the other hand, dry deposition, estimated in the northeastern U.S. to be about half of the



Source: Latimer 1989

Figure 3-18. COMPARISON OF CALCULATED AND MEASURED LIGHT EXTINCTION (b_{ext}) AT JARBIDGE WILDERNESS AREA IMPROVE SITE IN SUMMER 1988

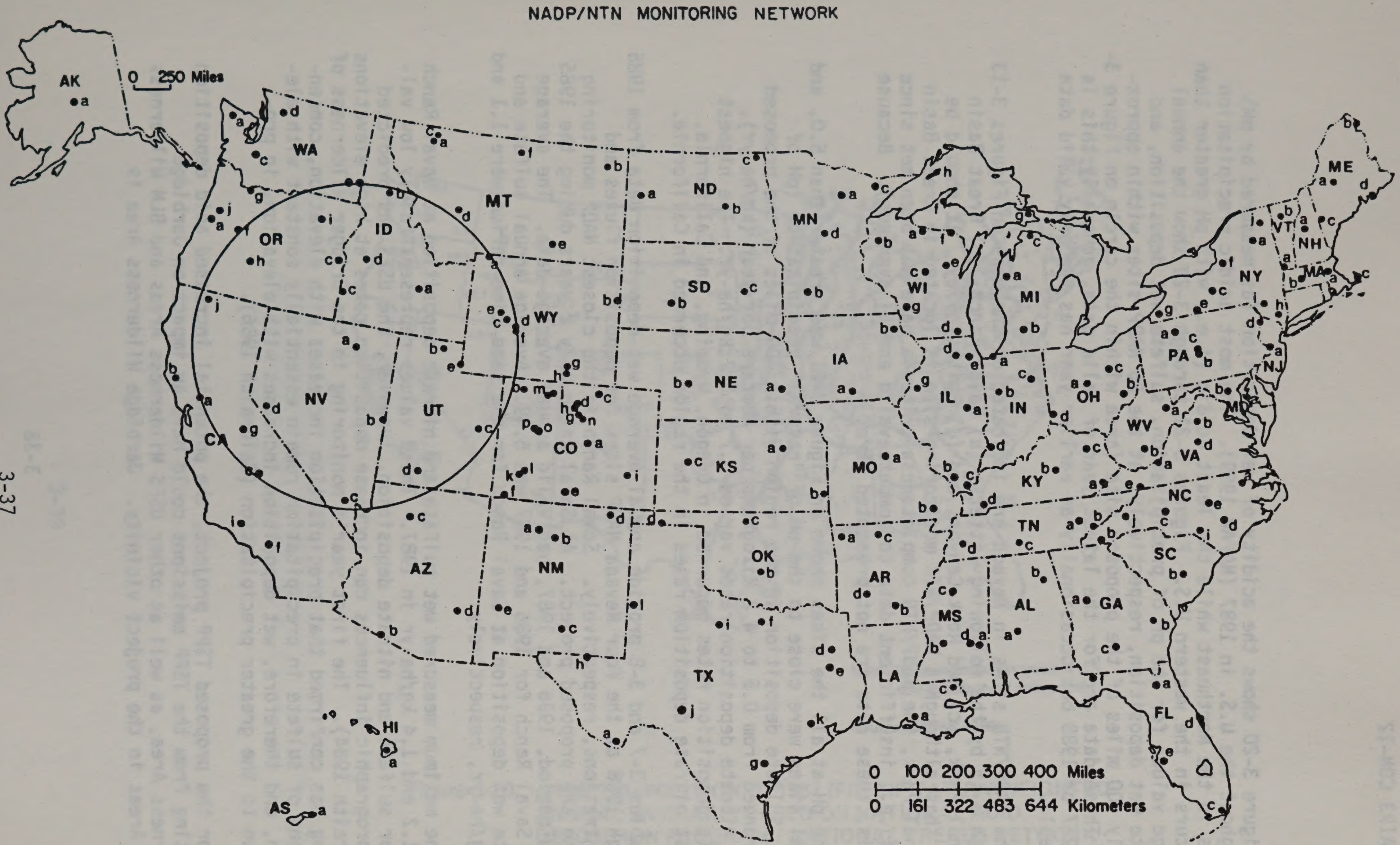
total acid deposition, consists of gases and solid particles that settle to the surface (Electric Power Research Institute [EPRI] 1983). Soluble acidic precursors in dry deposition can go into solution upon contact with surface water and form acidic compounds.

The forms of acidic deposition that pose the largest potential threats to sensitive ecosystems are not precisely known and likely vary from area to area. For example, summer rains are generally more acidic than snow in both the eastern and western U.S.; however, acidic snow is probably of greater concern than acidic rain in the West. Snowfall is the major form of precipitation in many elevated areas of the West, and in addition, acidic materials that accumulate in snowpacks during the winter can be released rapidly when the snow begins to melt (i.e., acid shock). Studies in Europe and the eastern U.S. have shown that up to half the acids in snowpacks can be released in the first 10 percent of the meltwaters (Johannes et al. 1980). In arid and semi-arid areas, such as the western U.S., most acid deposition is probably dry deposition.

Increases in anthropogenic emissions of sulfur oxides (SO_x) and nitrogen oxides (NO_x) are generally believed to be the reason for increased acidity in precipitation in many parts of the world (California Air Resources Board [CARB] 1985; Glass 1982). Man-made sulfur emissions come from a variety of source types including combustion of coal and oil in industrial plants, with electric utilities accounting for over two-thirds of the total (National Acid Precipitation Assessment Program [NAPAP] 1989). Sulfates ($SO_4^=$) and nitrates (NO_3^-), formed from oxidation of SO_x and NO_x compounds, are precursors of sulfuric acid (H_2SO_4) and nitric acid (HNO_3), respectively, which are the primary acidic species in acid deposition (Schwarz 1989; Glass 1979, 1982). Other acids, such as hydrochloric acid and organic acids, may also contribute a fraction to the total acidity (Barrie 1981).

Throughout Europe, southeastern Canada, and the eastern U.S., the average pH of precipitation ranges from 4 to 4.5 (Dillon 1978; Kurtz and Scheider 1981; Wolff 1979; Sequeira 1982a). Precipitation with a pH as low as 2.4 has been observed (Likens et al. 1979). In the western U.S., an annual average pH of 4.6 was reported for an area in Colorado near the continental divide (in Boulder County 6 km east of the continental divide) (Lewis and Grant 1981); a pH of 4.1 was reported for Pasadena, California (Liljestrand and Morgan 1978).

In recent years, the National Acid Deposition Program/National Trends Network (NADP/NTN) has been measuring acidic precipitation across the United States to create a data base designed to identify regional patterns. By January 1989, 87 monitoring sites had been located east of the Mississippi River and 105 monitoring sites had been established west of the Mississippi River (NADP/NTN 1989). The locations of the NADP/NTN sites, as of January 1989, are shown on Figure 3-19.



Source: NADP 1989

Figure 3-19. LOCATIONS OF ACTIVE SITES IN THE NADP/NTN NETWORK AS OF AUGUST 15, 1989

Figure 3-20 shows the acidity of wet deposition (as measured by pH) throughout the U.S. in 1987 (NAPAP 1989). The most acidic precipitation occurs in the Northeast while the least acidic (i.e., with pH greater than 5) occurs in the western U.S. Figures 3-21 through 3-23 show the annual average values for the pH of precipitation, sulfate wet deposition, and nitrate wet deposition, respectively, at the 26 NADP sites within approximately 400 miles of the proposed site (area within the circle on Figure 3-19). These data are for the latest year of valid data, generally this is for 1987 or 1988 but occasionally an earlier year has the only valid data available.

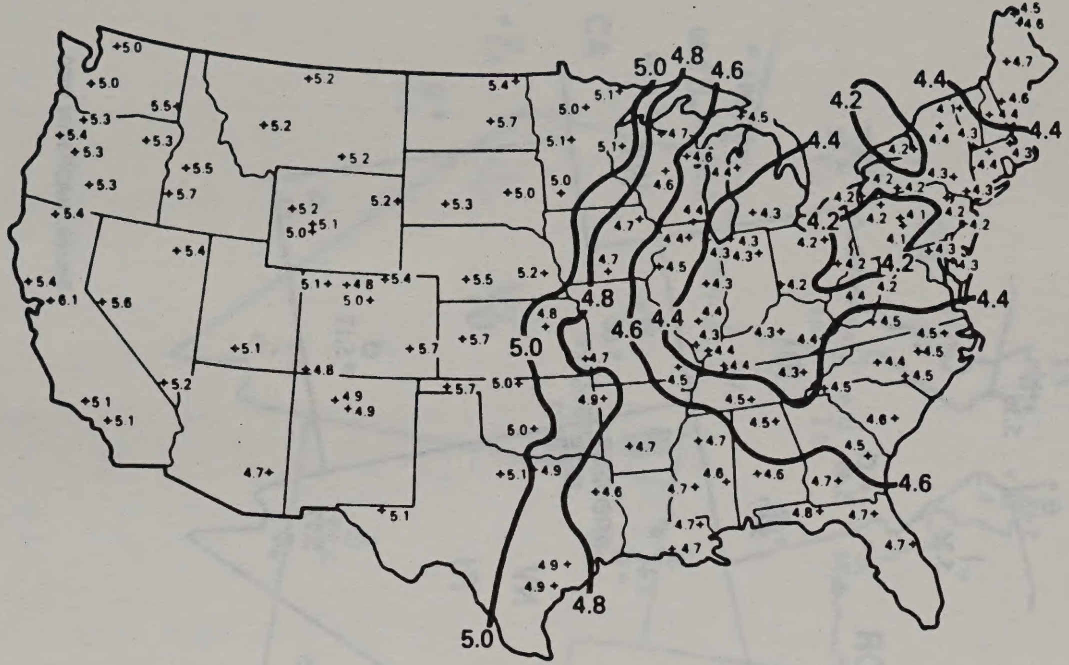
The NADP/NTN sites in Nevada are indicated on the maps on Figures 3-13 through 3-15 by the following letters: (a) Saval Ranch, (b) Great Basin National Park, (c) Red Rock Canyon, and (d) Smith Valley. It should be noted that although a NADP/NTN monitoring site is located in Great Basin National Park, the NADP/NTN completeness criteria have not been met since 1985 (i.e., insufficient data to compute valid annual averages). Because of this, these data are not presented here.

The pH at all the sites shown on Figure 3-21 was greater than 5.0, and several sites were close to the pH of "natural" precipitation (pH of 5.6). Sulfate deposition in the region within 400 miles of the proposed site ranged from 0.5 to 4.2 kilograms per hectare per year (kg/ha-yr), while nitrate deposition rates varied 0.7 to 5.2 kg/ha-yr. The highest sulfate deposition rates occurred in Oregon, Wyoming, and California. Highest nitrate deposition rates in the region occurred in California.

Tables 3-7 and 3-8 provide annual average wet deposition data from 1985 through 1988 at the four Nevada NADP sites for deposition fluxes and concentrations, respectively. Saval Ranch is the closest NADP monitoring site to the proposed project. At Saval Ranch only 2 years during the 1985 - 1988 period, 1986 and 1987, had valid annual average data. The average pH at Saval Ranch for 1986 and 1987 was 5.49. Average annual sulfate and nitrate wet deposition at Saval Ranch for the same time period were 1.1 and 1.3 kg/ha-yr, respectively.

The maximum measured wet sulfate and nitrate deposition at Saval Ranch were 1.2 and 1.4 kg/ha-yr in 1987. These values represent fairly low values for sulfate and nitrate deposition. However, the USFS has predicted that orographic influences can increase deposition rates at high elevations (Galbraith 1984). The first year's monitoring in the Bridger Wilderness of Wyoming has confirmed that precipitation increases with elevation, concentrations of sulfate in precipitation remain essentially constant with elevation, and therefore, wet deposition increases with elevation, in proportion to the greater precipitation (Galbraith 1986).

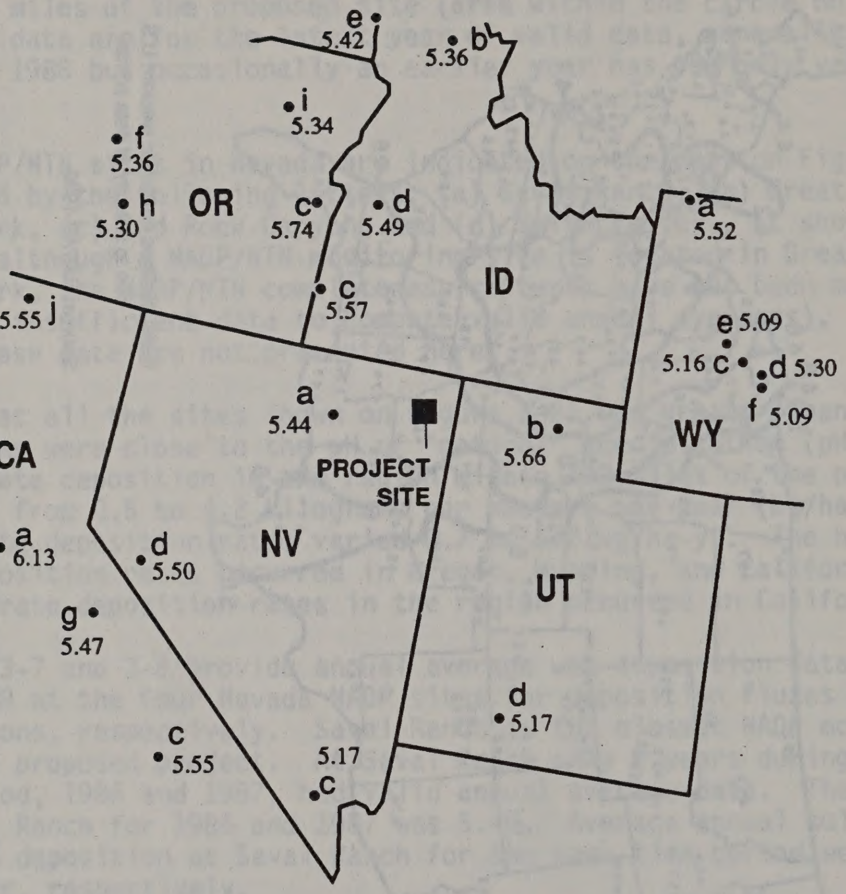
For the proposed TSPP project, the potential increased acid deposition resulting from the TSPP emissions could have an impact on Jarbidge Wilderness Area, as well as other USFS Wilderness Areas and BLM Wilderness Study Areas in the project vicinity. Jarbidge Wilderness Area is



Note: Isolines omitted in western U.S.
due to scarcity of data points.

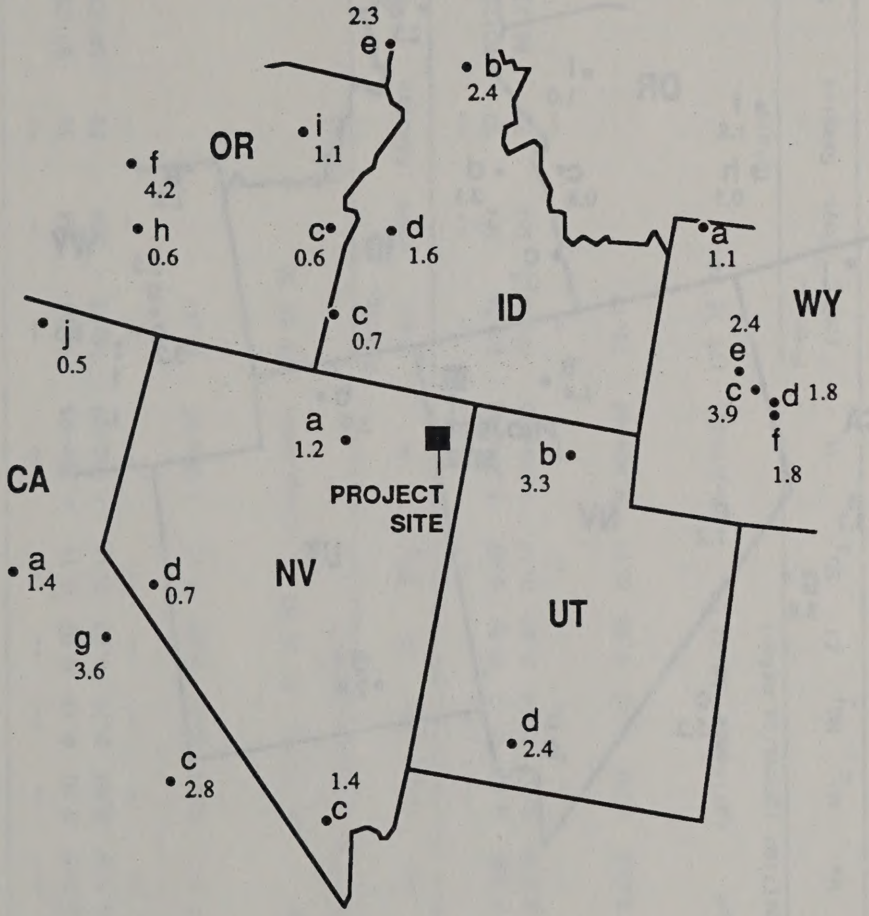
Source: NAPAP 1989

Figure 3-20. pH WET DEPOSITION IN 1987 (PRECIPITATION-WEIGHTED ANNUAL AVERAGE) BASED ON NATIONAL ACID DEPOSITION PROGRAM / NATIONAL TRENDS NETWORK



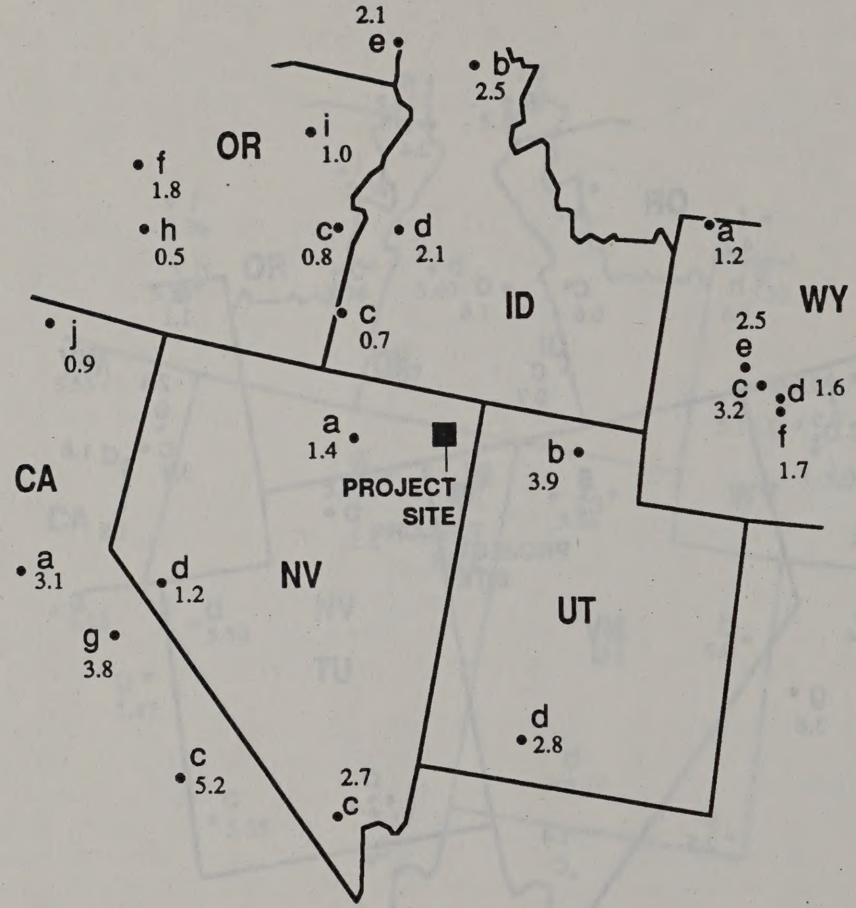
Source: NADP/NTN 1989

Figure 3-21. ANNUAL pH WITHIN 400 MILES OF THE TSPP SITE BASED ON MOST RECENT VALID AVERAGES



Source: NADP/NTN 1989

Figure 3-22. ANNUAL SULFATE WET DEPOSITION (kg/ha-yr as SO_4) WITHIN 400 MILES OF THE TSPP SITE BASED ON MOST RECENT AVERAGES



Source: NADP/NTN 1989

Figure 3-23. ANNUAL NITRATE WET DEPOSITION (kg/ha-yr as NO_3) WITHIN 400 MILES OF THE TSPP SITE BASED ON MOST RECENT AVERAGES

Table 3-7. ANNUAL WET DEPOSITION DATA (DEPOSITION FLUXES [g/sq.m]) FOR NEVADA NADP/NTN SITES (1985-1988)

Red Rock Canyon
Clark County, NV
Elevation: 3730 feet Latitude: 36 08 09 Longitude: 115 25 32

Year	Deposition (grams/sq.meter)									Totals			
	Ca	Mg	K	Na	NH_4	NO_3	Cl	SO_4	H	Precip. (cm)	Days	Samples	Dates
1985[a]	--	--	--	--	--	--	--	--	--	--	--	--	--
1986	0.05	0.008	0.003	0.015	0.03	0.18	0.02	0.11	1.26e-03	14.01	364	52	851231 861230
1987	0.07	0.010	0.004	0.019	0.04	0.27	0.03	0.14	1.29e-03	19.02	364	52	861230 871229
1988[a]	--	--	--	--	--	--	--	--	--	--	--	--	--
Average	0.06	0.009	0.004	0.017	0.04	0.23	0.03	0.13	1.28e-03	16.51			

Saval Ranch
Elko County, NV
Elevation: 6070 feet Latitude: 41 16 59 Longitude: 115 49 36

Year	Deposition (grams/sq.meter)									Totals			
	Ca	Mg	K	Na	NH_4	NO_3	Cl	SO_4	H	Precip. (cm)	Days	Samples	Dates
1985[a]	--	--	--	--	--	--	--	--	--	--	--	--	--
1986	0.03	0.006	0.004	0.026	0.02	0.12	0.02	0.09	7.80e-04	26.24	364	52	851231 861230
1987	0.04	0.008	0.008	0.039	0.03	0.14	0.03	0.12	1.10e-03	30.09	364	52	861230 871229
1988[a]	--	--	--	--	--	--	--	--	--	--	--	--	--
Average	0.04	0.007	0.006	0.033	0.03	0.13	0.03	0.11	9.40e-04	28.17			

Smith Valley
Lyon County, NV
Elevation: 4925 feet Latitude: 38 47 57 Longitude: 119 15 24

Year	Deposition (grams/sq.meter)									Totals			
	Ca	Mg	K	Na	NH_4	NO_3	Cl	SO_4	H	Precip. (cm)	Days	Samples	Dates
1985[a]	--	--	--	--	--	--	--	--	--	--	--	--	--
1986	0.01	0.002	0.005	0.012	0.02	0.07	0.01	0.04	3.47e-04	13.95	364	52	851231 861230
1987	0.02	0.004	0.006	0.018	0.05	0.13	0.02	0.09	4.84e-04	19.39	364	52	861230 871229
1988	0.02	0.003	0.005	0.014	0.03	0.12	0.02	0.07	4.17e-04	13.11	371	53	871229 890103
Average	0.02	0.003	0.005	0.015	0.03	0.11	0.02	0.07	4.17e-004	15.48			

Source: NADP/NTN 1989

[a] Insufficient data were collected to compute valid annual averages.

Table 3-8. ANNUAL WET DEPOSITION DATA (CONCENTRATIONS [mg/l]) FOR NEVADA NADP/NTN SITES (1985-1988)

Red Rock Canyon
Clark County, NV
Elevation: 3730 feet Latitude: 36 08 09 Longitude: 115 25 32

Year	Precipitation Weighted Averages (mg/L)										Totals			
	Ca	Mg	K	Na	NH_4	NO_3	Cl	SO_4	pH	Conduct. (uS/cm)	Precip. (cm)	Days	Samples	Dates
1985[a]	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1986	0.38	0.059	0.018	0.106	0.21	1.32	0.15	0.79	5.05	9.9	14.01	364	52	851231 861230
1987	0.39	0.053	0.019	0.102	0.23	1.42	0.16	0.72	5.17	9.0	19.02	364	52	861230 871229
1988[a]	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Average	0.39	0.056	0.019	0.104	0.22	1.37	0.16	0.76	5.11	9.5	16.52			

Saval Ranch
Elko County, NV
Elevation: 6070 feet Latitude: 41 16 59 Longitude: 115 49 36

Year	Precipitation Weighted Averages (mg/L)										Totals			
	Ca	Mg	K	Na	NH_4	NO_3	Cl	SO_4	pH	Conduct. (uS/cm)	Precip. (cm)	Days	Samples	Dates
1985[a]	--	--	--	--	--	--	--	--	--	--	--	--	--	
1986	0.13	0.023	0.017	0.100	0.08	0.44	0.08	0.35	5.53	4.3	26.24	364	52	851231 861230
1987	0.15	0.025	0.025	0.130	0.09	0.46	0.11	0.39	5.44	4.9	30.09	364	52	861230 871229
1988[a]	--	--	--	--	--	--	--	--	--	--	--	--	--	
Average	0.14	0.024	0.021	0.115	0.09	0.45	0.10	0.37	5.49	4.6	28.16			

Smith Valley
Lyon County, NV
Elevation: 4925 feet Latitude: 38 47 57 Longitude: 119 15 24

Year	Precipitation Weighted Averages (mg/Liter)										Totals			
	Ca	Mg	K	Na	NH_4	NO_3	Cl	SO_4	pH	Conduct. (uS/cm)	Precip. (cm)	Days	Samples	Dates
1985[a]	--	--	--	--	--	--	--	--	--	--	--	--	--	
1986	0.09	0.017	0.038	0.083	0.13	0.49	0.10	0.31	5.60	4.2	13.95	364	52	851231 861230
1987	0.09	0.019	0.029	0.094	0.25	0.66	0.11	0.47	5.60	6.4	19.39	364	53	871229 890103
1988	0.13	0.020	0.036	0.108	0.25	0.89	0.13	0.56	5.50	6.4	13.11	371	53	871229 890103
Average	0.13	0.019	0.034	0.095	0.21	0.68	0.11	0.45	5.57	5.2	15.48			

Source: NADP/NTN 1989

[a] Insufficient data were collected to compute valid annual averages.

particularly important since it is a Federally designated Class I area, located about 75 km (47 miles) northwest of the proposed TSPP project site.

Precipitation in the area of the proposed TSPP project site and Jarbidge Wilderness does appear to vary with elevation and location. As shown previously in Table 3-1, the Jarbidge site, located near the Pole Creek Ranger Station near the northeastern boundary of the wilderness at an elevation of about 8330 feet, had an annual average annual precipitation of 24.5 inches for the period from 1961 to 1985. This is considerably higher than the precipitation amounts reported for the other locations listed in Table 3-1, with elevations ranging from 5050 to 6100 feet, suggesting fairly strong orographic effects.

To obtain representative background sulfate and nitrate deposition rates in Jarbidge Wilderness Area, the Saval Ranch NADP/NTN deposition data have been scaled to the higher elevations within Jarbidge Wilderness Area to account for orographic effects. Two assumptions have been made, as suggested by the USFS (Galbraith 1984 and 1986), in accounting for these effects. The first is that sulfate and nitrate concentrations are constant with elevation, and the second that total deposition can be scaled by precipitation amount.

Precipitation at different elevations within Jarbidge Wilderness Area was estimated using the procedure developed by WCC (1989) for estimating precipitation over the Thousand Springs Basin. That procedure is summarized as follows:

- The total monthly precipitation data collected over 18 years (1963 - 1980) from 23 precipitation measuring stations distributed over the Rock Springs Creek watershed were analyzed to derive mean annual precipitation for each station for the monitoring period. Also, the National Oceanographic and Atmospheric Administration (NOAA) data for the corresponding period from the Contact, Metropolis, Montello, Pequop, and Wells precipitation stations were analyzed to derive mean annual precipitation measures for those stations.

- The mean annual precipitation values for the 28 stations analyzed (see Table 3-9) were plotted against the station elevations and a regression curve fitted to the data. The equation of the curve was:

$$P = -12.691 + 0.004285 \times E$$

Where:

P = the mean annual precipitation in inches, at any point in the vicinity of Thousand Springs Basin
E = the elevation of the point in feet above mean sea level

Table 3-9. AVERAGE ANNUAL PRECIPITATION AT NOAA AND BLM MONITORING STATIONS, 1963-1980

Agency and Monitoring Station	Elevation (feet)	Precipitation (inches)
NOAA Station		
Contact	5365	10.81
Metropolis	5800	14.12
Montello	4880	8.32
Pequop	6030	13.17
Wells	5650	10.71
BLM Stations		
Rock Spring - 1	5500	11.45
Rock Spring - 2	5740	11.50
Rock Spring - 3	5900	10.84
Rock Spring - 4	6320	13.15
Rock Spring - 5	6480	15.54
Rock Spring - 6*	6600	13.02
Rock Spring - 7	5780	11.24
Rock Spring - 8	6240	12.82
Rock Spring - 9	6520	15.50
Rock Spring - 10*	7380	16.34
Rock Spring - 11	5700	11.34
Rock Spring - 12	5900	12.74
Rock Spring - 13	6200	14.64
Rock Spring - 14	6500	15.77
Rock Spring - 15	6320	15.03
Rock Spring - 16	5870	12.94
Rock Spring - 17	5880	11.89
Rock Spring - 18	5960	12.51
Rock Spring - 19	5940	11.82
Rock Spring - 20	5590	11.60
Rock Spring - 21	5460	11.55
Rock Spring - 22	6520	16.18
Rock Spring - 23	6440	14.83

Developed by Woodward-Clyde Consultants based on NOAA (1949-1988) and BLM (1983) data.

* Outlier data not used to develop orographic relationship.

R^2 of the regression was 0.818

Figure 3-24 shows a plot of the data used in the regression analysis and the resulting fitted curve.

To assess whether this relationship developed for orographic effects in Thousand Springs Basin was acceptable for use in Jarbidge Wilderness Area, the regression equation was used to predict the precipitation at the Pole Creek station in Jarbidge at an elevation of 8330 feet. The predicted precipitation was within 6 percent of the actual annual average precipitation of 24.5 inches. For the purposes of extrapolating the Saval Ranch deposition data to elevations within Jarbidge, a difference of 6 percent in precipitation was considered acceptable.

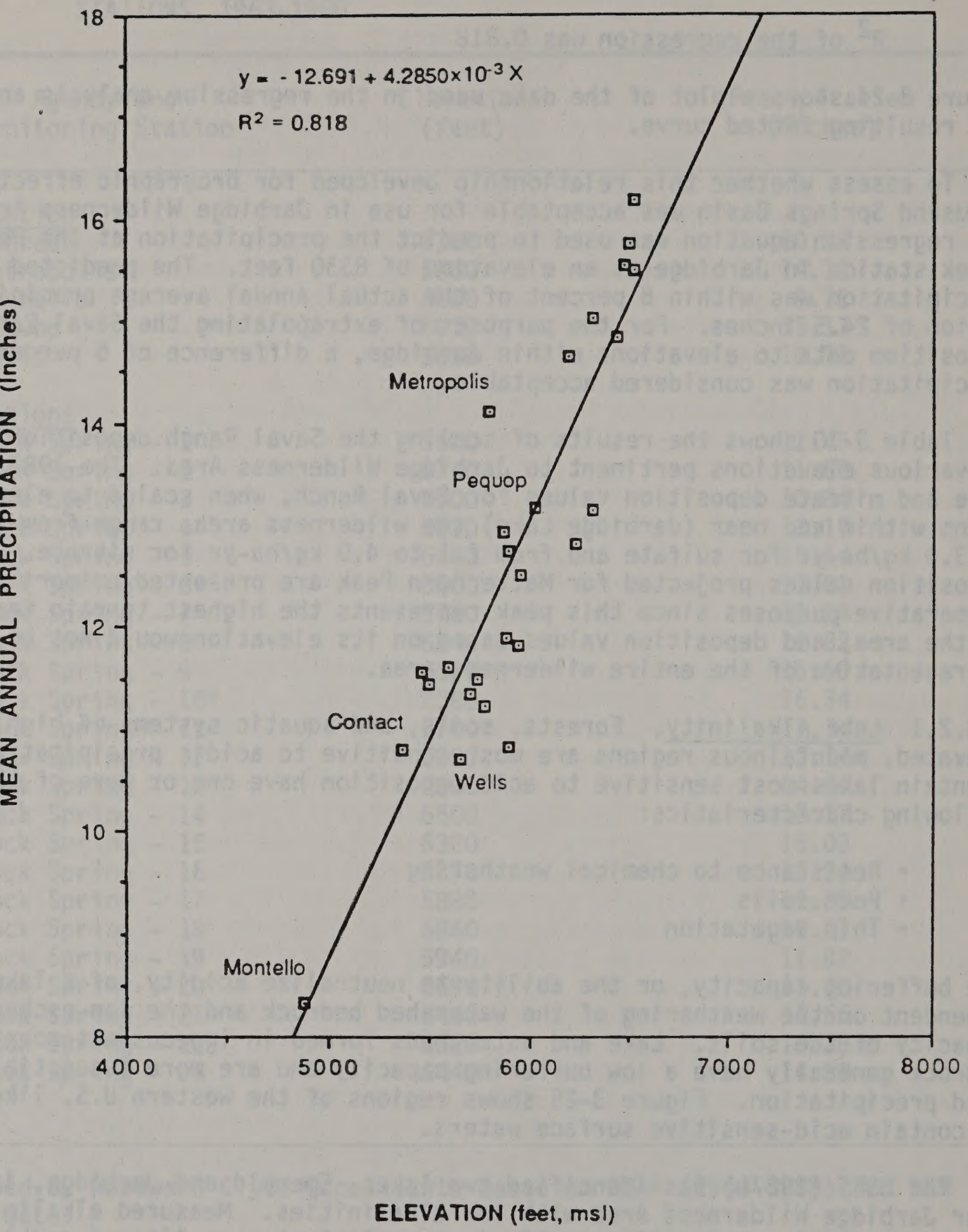
Table 3-10 shows the results of scaling the Saval Ranch deposition data to various elevations pertinent to Jarbidge Wilderness Area. The 1987 sulfate and nitrate deposition values for Saval Ranch, when scaled to elevations within and near (Jarbidge Lake) the wilderness area, range from 1.8 to 3.4 kg/ha-yr for sulfate and from 2.1 to 4.0 kg/ha-yr for nitrate. The deposition values projected for Matterhorn Peak are presented primarily for comparative purposes since this peak represents the highest terrain feature in the area, and deposition values based on its elevation would not be representative of the entire wilderness area.

3.3.2.1 Lake Alkalinity. Forests, soils, and aquatic systems of highly elevated, mountainous regions are most sensitive to acidic precipitation. Mountain lakes most sensitive to acid deposition have one or more of the following characteristics:

- Resistance to chemical weathering
- Poor soils
- Thin vegetation

The buffering capacity, or the ability to neutralize acidity, of a lake is dependent on the weathering of the watershed bedrock and the ion-exchange capacity of the soils. Lake and watersheds formed in igneous metamorphic bedrock generally have a low buffering capacity and are more susceptible to acid precipitation. Figure 3-25 shows regions of the western U.S. likely to contain acid-sensitive surface waters.

The USFS (1987b) has identified two lakes, Emerald and Jarbidge, in or near Jarbidge Wilderness Area with low alkalinities. Measured alkalinities at these two lakes were 131 and 35 micro equivalents per liter (µeq/L), respectively, sufficiently low to classify the lakes as "sensitive" and ultrasensitive". Because of such acid-sensitive watersheds, the USFS speculates that 5 to 15 kg/ha-yr of total sulfate deposition could cause damage in sensitive watersheds (USFS 1987b). The USFS has defined LACs in the Jarbidge Wilderness Area for acid deposition effects as 0.1 of a pH unit and 5 kg/ha-yr of depositional sulfate (USFS 1987b).



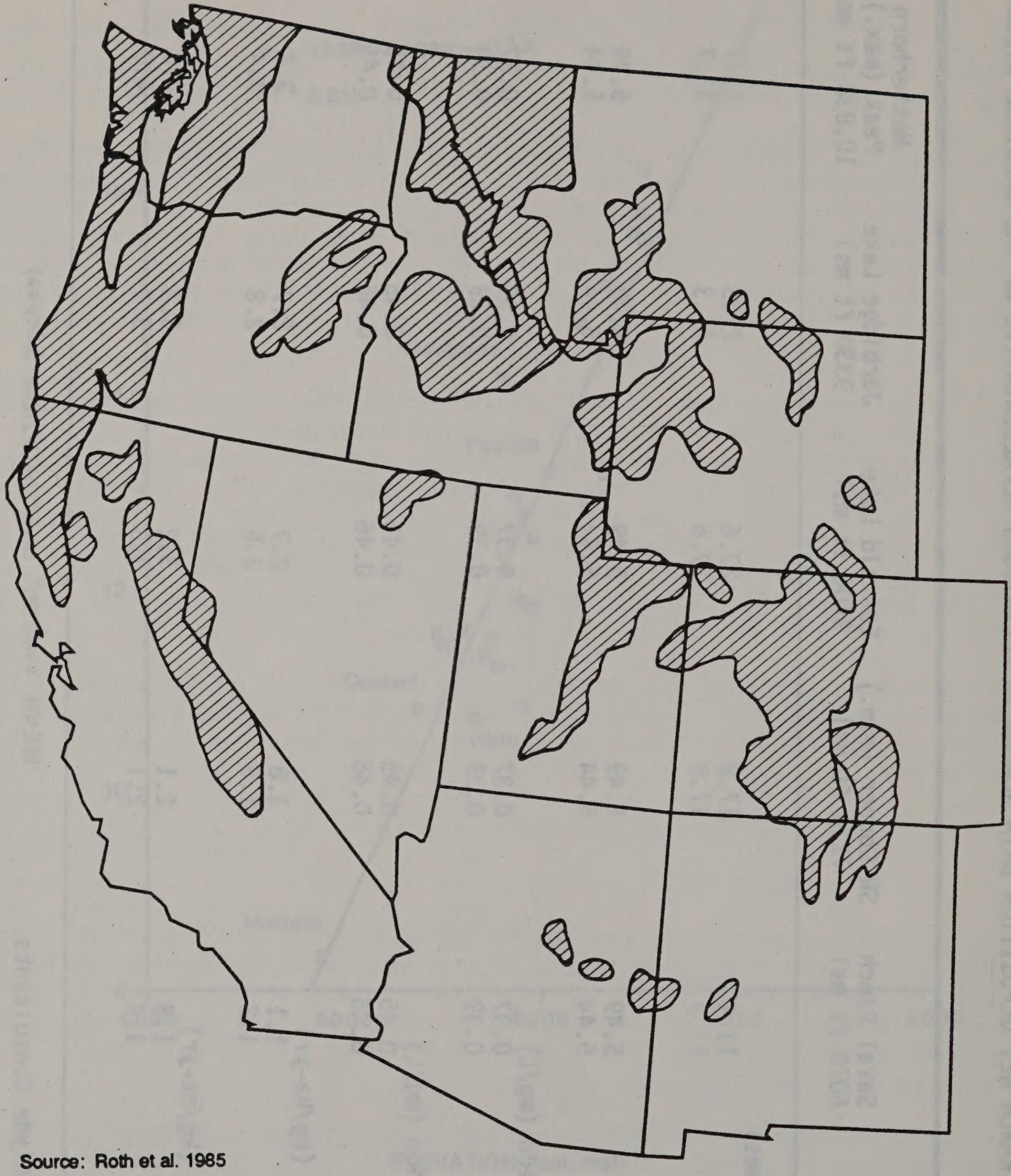
Source: Orographic analysis performed by Woodward-Clyde Consultants based on NOAA and BLM data

Figure 3-24. MEAN ANNUAL PRECIPITATION VERSUS ELEVATION AT NOAA AND BLM STATIONS, 1963 – 1980

Table 3-10. SAVAL RANCH WET DEPOSITION DATA SCALED TO ELEVATIONS REPRESENTATIVE OF THE JARBIDGE WILDERNESS AREA

Parameter	Saval Ranch 6070 ft msl	SW Corner (min.) 7120 ft msl	Emerald Lake 9400 ft msl	Jarbidge Lake 9330 ft msl	Matterhorn Peak (max.) 10,838 ft msl
Precipitation (inches)					
1986-1987	11.1	17.8	27.6	27.3	33.7
1987	11.8	17.8	27.6	27.3	33.7
pH					
1986-1987	5.49	5.49	5.49	5.49	5.49
1987	5.44	5.44	5.44	5.44	5.44
Sulfate Concentration (mg/L)					
1986-1987	0.37	0.37	0.37	0.37	0.37
1987	0.39	0.39	0.39	0.39	0.39
Nitrate Concentration (mg/L)					
1986-1987	0.45	0.45	0.45	0.45	0.45
1987	0.46	0.46	0.46	0.46	0.46
Sulfate Deposition (kg/ha-yr)					
1986-1987	1.1	1.8	2.7	2.7	3.4
1987	1.2	1.8	2.8	2.8	3.4
Nitrate Deposition (kg/ha-yr)					
1986-1987	1.3	2.1	3.2	3.2	4.0
1987	1.4	2.1	3.3	3.2	4.0

Source: Woodward-Clyde Consultants



Source: Roth et al. 1985

Not to scale

Figure 3-25. WESTERN REGIONS LIKELY TO CONTAIN ACID SENSITIVE SURFACE WATERS

3.3.3 Lichens

Lichens have long been used as bioindicators of air pollution. Lichens are a symbiotic association between algae and fungi. They may be the plant group most sensitive to air pollution. They have no root system, and are able to obtain nutrients from the air. Having no excretion systems, they retain and concentrate atmospheric materials. It has been shown that lichens effectively accumulate a wide variety of pollutants washed from the atmosphere by precipitation. Thus, lichen may provide an effective record of the types of materials in the atmosphere. Additionally, airborne acids will cause lichen chlorosis, phaeophytin formation, or plasmolysis due to sensitivity of the algae symbiont to thallus damage.

Elemental analysis of lichen tissues as a pollution monitoring device has progressed to the point that it is now possible to measure specific elements. This makes chemical analysis of lichens a useful indicator of atmospheric pollutants. Because of the varying sensitivity of different lichen species to air pollution and their long life span they are a useful sensitive receptor for air pollution studies. Thallus concentrations of lead, sulfur, and copper have been determined for indicator species in Jarbidge Wilderness Area and are provided in Table 3-11. Thallus sulfur concentrations for some species are currently near a level (0.2 percent) that may be considered detrimental to most lichens.

As described in St. Clair (1989), Jarbidge Wilderness Area is generally an excellent clean air reference site for western North America. Preliminary comparisons of Jarbidge Wilderness Area data with other lichen data from Utah, Idaho, and California consistently indicates that the lichens in Jarbidge Wilderness Area have been only minimally impacted at this time. An ongoing study is being conducted to document pollution-related changes in the lichen flora.

3.4 EXISTING AMBIENT AIR QUALITY

Air quality in the project region is generally good (BLM 1984). The major contributor to air pollution is particulate matter resulting from wind-blown dust, especially from disturbed areas and from forest fires, either natural or man-caused, and controlled burning. Air quality is governed by two major factors, pollutant emissions and meteorological conditions. Meteorological factors such as windspeed, atmospheric stability, and mixing depth all affect the dispersion rate of emitted pollutants, while solar radiation affects photochemical oxidant production. Frequent short-term variations in air quality usually result from changes in atmospheric conditions. Long-term variations typically result from changes in pollutant emissions.

The area within a 100-km radius of the proposed sites includes federal Air Quality Control Regions (AQCR) area that have been designated as "attainment" (Better than National Standards or Can Not be Classified) of federal NAAQS for all criteria pollutants (ozone, particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead). The nearest

Table 3-11. ELEMENTAL ANALYSIS DATA FOR SELECTED LICHEN SPECIES FROM SELECTED SITES IN THE JARBIDGE WILDERNESS AREA, HUMBOLDT NATIONAL FOREST, NEVADA

STUDY SITES SPECIES/SUBSTRATE	Copper (ppm)		Lead (ppm)		Percent Sulfur	
	1987	1988	1987	1988	1987	1988
SLIDE CREEK						
Letharia vulpina (bark)	3.40	--	7.40	--	0.102	--
Dermatocarpon miniatum (rock)	1.90	--	2.30	--	0.412	--
SNOWSLIDE						
Dermatocarpon miniatum (rock)	1.00	--	3.10	--	0.275	--
SAWMILL RIDGE						
Letharia vulpina (bark)	3.70	--	14.30	--	0.102	--
HUMMINGBIRD RIDGE						
Letharia vulpina (bark)	3.80	3.90	9.70	11.10	0.226	0.141
EMERALD LAKE						
Letharia vulpina (bark)	2.20	--	12.60	--	0.215	--
BALOTH RIDGE						
Rhizoplaca melanophthalma (rock)	--	9.60	--	18.00	--	0.01
RIDGE ABOVE MARY'S RIVER BASIN						
Letharia vulpina (bark)	--	3.10	--	13.00	--	0.162
ALONG MARY'S RIVER						
Dermatocarpon miniatum (rock)	--	6.50	--	4.50	--	0.242
WATERSHED DIVIDE BETWEEN SLIDE CREEK AND HUMMINGBIRD RIDGE						
Letharia vulpina (bark)	--	3.40	--	29.50	--	0.097

Source: St. Clair 1989.

nonattainment area (nonattainment for sulfur dioxide) is in the southern portion of the Steptoe Valley (AQCR 179), located more than 100 km south of the project site. With respect to fine particulate matter (i.e., particulate matter smaller than 10 μm, or "PM_{10}"), the area is classified by the EPA as "Group III", which means the area has less than a 20 percent chance of exceeding the federal PM_{10} standards. In addition, the area is currently in attainment of all applicable Nevada air quality standards.

Air quality was monitored at the proposed project site over the period June 15, 1981 through June 14, 1982 (WCC 1982). The pollutants included in the monitoring program were:

- Sulfur dioxide (SO_2)
- Nitrogen dioxide (NO_2)
- Total Suspended Particulate (TSP)
- PM less than 15 micrometers in diameter (PM_{15})
- Ozone (O_3)
- Lead (Pb)
- Arsenic (As)
- Fluoride (F)

Lead and arsenic were measured on both the TSP and PM_{15} samples. PM_{10} was not monitored during this period since the standards for PM_{10} were not in existence at that time. During the period September 6, 1988 through September 25, 1989, PM_{10} and TSP data have been monitored. Table 3-12 summarizes the maximum ambient air pollutant concentrations monitored at the proposed TSPP site. All pollutant concentrations listed in Table 3-12, except for TSP and PM_{10}, are from data collected during the 1981-1982 monitoring period. TSP and PM_{10} data presented are from the 1988-1989 monitoring period. The monitored ambient concentrations are well below the ambient air quality standards. The ambient air quality has not degraded since the 1981-1982 monitoring program, as no new sources have been permitted in the area.

The monitored ambient concentrations, listed in Table 3-12 are used as representative background air quality and can be added to predicted impacts from the proposed power plant to obtain total ambient air pollutant concentrations. The total concentration for each pollutant will be compared to applicable ambient air quality standards for demonstration of compliance.

3.5 EMISSION INVENTORY

Several air pollution source emission inventories were developed as part of the procedure for assessing potential impacts of the TSPP project, as well as for comparative purposes. These inventories are described below.

Table 3-12. SUMMARY OF MAXIMUM AMBIENT AIR POLLUTANT CONCENTRATIONS AT TSPP SITE

Pollutant/ Averaging Time	Concentration	National and State Standards
SO_2		
3-hour[a]	44 $\mu g/m^3$	1300 $\mu g/m^3$
24-hour	13 $\mu g/m^3$	365 $\mu g/m^3$
Annual	3 $\mu g/m^3$	80 $\mu g/m^3$
NO_2		
1-hour	10 $\mu g/m^3$	--
Annual	2 $\mu g/m^3$	100 $\mu g/m^3$
O_3		
1-hour	123 $\mu g/m^3$	235 $\mu g/m^3$
TSP		
24-hour[a]	44.7 $\mu g/m^3$	150 $\mu g/m^3$
Annual[a]	16.6 $\mu g/m^3$	75 $\mu g/m^3$
PM_{10}		
24-hour[b]	20.1 $\mu g/m^3$	150 $\mu g/m^3$ (PM_{10})
Annual[b]	8.4 $\mu g/m^3$	50 $\mu g/m^3$ (PM_{10})
Pb[c]		
24-hour	.11 $\mu g/m^3$	--
Quarter	<.05 $\mu g/m^3$	1.5 $\mu g/m^3$
Pb_{15}[c]		
24-hour	.10 $\mu g/m^3$	--
Quarter	<.05 $\mu g/m^3$	--
As		
24-hour	.19 $\mu g/m^3$	--
As_{15}		
24-hour	.13 $\mu g/m^3$	--

Table 3-12. SUMMARY OF MAXIMUM AMBIENT AIR POLLUTANT CONCENTRATIONS AT TSPP SITE (concluded)

Pollutant/ Averaging Time	Concentration	National and State Standards
F (Particulate)		
24-hour	.26 $\mu g/m^3$	--
F (Gas)		
24-hour	.36 $\mu g/m^3$	--

Source: Woodward-Clyde Consultants

[a] State standard only.

[b] National standard only.

[c] Pb and As were measured on TSP samples while Pb_{15} and As_{15} were measured on PM_{15} samples.

Note: All pollutant concentrations listed, with the exception of TSP and PM_{10}, are from the June 15, 1981 to June 14, 1982 monitoring period. TSP and PM_{10} data were collected during the September 9, 1988 to September 25, 1989 monitoring period.

3.5.1 Major Source Inventory

According to the Nevada Division of Environmental Protection (NDEP) (NDEP 1989a), there are no sources within 100 km of the proposed TSPP project site that emit more than 100 tons/yr of any pollutant regulated under the Clean Air Act (i.e., no Prevention of Significant Deterioration [PSD] sources). Thus, there are no other "major sources" in the vicinity of the proposed project that would be subject to PSD requirements, or would have a significant impact (discussed in Section 2.3.1) in the region where the TSPP would locate. This means that none of the PSD increments for SO_2, NO_2, or TSP matter have been reserved by any other major sources.

While there are no major sources within 100 km of the TSPP site, there are other existing or proposed utility power plant sources in Nevada and western Utah for which concerns of potential cumulative impacts have been expressed. These sources are listed in Table 3-13. The closest power plant to the proposed TSPP is the North Valmy Power Plant located near Winnemucca, about 140 miles (225 km) west-southwest of the TSPP site. In addition to the existing power plants there are the proposed Harry Allen power plant, 25 miles northeast of Las Vegas; and the White Pine power plant in White Pine County. Of these two proposed power plants only the Harry Allen plant currently has obtained a PSD permit and is included in the emission inventory, but has not yet been built. The White Pine power plant at one time had been issued a PSD permit. According to the NDEP the White Pine power plant's PSD permit has expired, and therefore, cannot be built unless it goes through the entire PSD permitting process once again.

As part of the NAPAP, emissions inventories of SO_2 and NO_x in the U.S. have been compiled EPA (1988a). Table 3-14 lists estimated emissions of SO_2 and NO_x from both point and area sources for the western U.S., in addition to total estimated U.S. emissions. Based on the 1985 NAPAP emission inventory, in the western U.S. about 2 million tons/yr of SO_2 and 3.3 million tons/yr of NO_x are emitted. Of that, Nevada contributes about 40,240 tons/yr of SO_2 and 112,672 tons/yr of NO_x.

3.5.2 Minor Source Inventory

An emission inventory for SO_2, NO_x, and TSP was also developed for minor sources (those sources not requiring PSD permits) permitted by the NDEP within 100 km of the proposed project site and for permitted sources located near Elko. This emission inventory was used to assess both short- and long-term local air quality impacts from the interaction of these sources with the proposed TSPP. Tables 3-15 and 3-16 list the short-term and long-term emissions, respectively, for sources in the inventory. Figure 3-26 shows the locations of the sources in the inventory.

3.5.3 Other Sources

As mentioned earlier, the major contributor to pollution in the project region is particulate matter. Region sources of PM emissions include forest fires, either natural or man-caused, and controlled burning. In order to estimate the quantity of fine particulates, in this case as PM_{10}, generated from controlled burning and other fires, the 10-year fire history

Table 3-13. MAJOR SOURCE EMISSION INVENTORY (SO_2 AND NO_2) FOR PROPOSED AND PERMITTED POWER PLANTS IN NEVADA AND WESTERN UTAH

				Annual Emission Rate					
Source Name	Source Type	Location (County, State)	Capacity (MMBtu/hr)	SO_2 (lb/hr)	NO_2 (lb/hr)	Stack Height (m)	Stack Diam. (m)	Stack Temp. (K)	Stack Vel. (m/sec)
Clark	Boiler 1	Clark, NV	450	350.1	231.0	30.5	2.6	383	13.8
Clark	Boiler 2	Clark, NV	565	439.5	297.0	30.5	2.7	416	16.0
Clark	Boiler 3	Clark, NV	662	529.6	341.0	47.6	3.4	414	13.9
				1319.2	869.0				
Harry Allen	Boiler	Clark, NV	5676	564.4	2497.8	175.0	6.7	327	20.1*
Harry Allen	Boiler	Clark, NV	5676	564.4	2497.8	175.0	6.7	327	20.1*
Harry Allen	Boiler	Clark, NV	5676	564.4	2497.8	175.0	6.7	327	20.1*
Harry Allen	Boiler	Clark, NV	5676	564.4	2497.8	175.0	6.7	327	20.1*
				2257.5	9991.2				
Sunrise	Boiler	Clark, NV	790	612.9	363.8	41.2	3.7	401	11.5
Reid Gardner	Boiler 1	Clark, NV	1115	613.3	880.9	61.0	3.8	338	12.3
Reid Gardner	Boiler 2	Clark, NV	1115	613.3	1059.3	73.2	3.8	338	14.8
Reid Gardner	Boiler 3	Clark, NV	1237	680.3	618.5	82.3	3.8	338	12.7
Reid Gardner	Boiler 4	Clark, NV	2956	857.2	1773.6	152.0	6.1	338	10.9
				2764.1	4332.3				
Valmy	Aux. Boiler	Humboldt, NV	112	156.7	16.0	64.0	1.0	557	27.4
Valmy	Boiler 1	Humboldt, NV	2499	2998.8	1750.5	52.4	5.8	499	20.2
Valmy	Boiler 2	Humboldt, NV	2499	1499.1	1249.5	138.7	5.2	359	23.0
				4654.6	3016.0				
White Pine	Boiler 1	White Pine, NV		1490	4424.8	229.0	7.9	344	19.6
White Pine	Boiler 2	White Pine, NV		1490	4424.8	229.0	7.9	344	19.6
				2980	8849.6				
Intermountain	Boiler 1	Millard, UT	8352	1063.0	3905.0	216.0	12.9	350	21.0
Intermountain	Boiler 2	Millard, UT	8352	1063.0	3905.0	216.0	12.9	350	21.0
				2126.0	7810.0				

Source: NDEP 1989

* Stack velocity calculated from volumetric flow rate and stack cross-sectional area.

Table 3-14. SULFUR DIOXIDE AND NITROGEN OXIDE EMISSIONS IN THE WESTERN U.S. BASED ON 1985 NAPAP EMISSION INVENTORY

	SO_2 (tons)			NO_x (Tons)		
State	Point Sources	Area Sources	Total	Point Sources	Area Sources	Total
Arizona	674,557	24,858	699,415	75,449	170,021	245,470
California	82,487	144,031	226,518	230,736	1,013,827	1,244,563
Colorado	76,322	15,111	91,433	133,034	158,808	291,842
Idaho	24,274	12,535	36,809	6,432	81,322	87,754
Montana	77,765	13,348	91,113	39,849	115,564	155,413
Nevada	34,216	6,024	40,240	62,427	50,245	112,672
New Mexico	249,620	21,808	271,428	184,159	100,688	284,847
Oregon	12,185	32,421	44,606	10,897	159,650	170,547
Utah	53,058	18,734	71,792	86,819	83,900	170,719
Washington	137,334	31,073	168,407	72,731	201,608	274,339
Wyoming	190,550	21,216	211,766	125,284	101,144	226,428
Total	1,612,368	341,159	1,953,527	1,027,817	2,236,777	3,264,594

Source: EPA (1988a)

Table 3-15. EMISSION INVENTORY OF PERMITTED SOURCES WITHIN 100 KILOMETERS OF TSPP SITE (SHORT-TERM)

Source Number	Company	Source Type	Location	Hours of Operation Per Year	Capacity[a]	TSP (lb/hr)	SO_2 (lb/hr)	NO_x (lb/hr)	CO (lb/hr)
1	Agriculture, Dept. of	Incinerator	S10 T34N R55E	600	0.08	0.22	0.31	0.22	0.00
2	Barrick	Autoclave	S09 T34N R55E	8760	73.50	0.51	28.47	26.95	0.00
3	Barrick	Boiler	S09 T34N R55E	8760	51.59	0.25	36.11	7.10	1.81
4	Barrick	Lime Silo	S09 T34N R55E	8760	5.74	0.24	--	--	--
5	Burns Funeral Home	Incinerator	S10 T34N R55E	2080	0.05	0.44	0.31	0.29	0.00
6	Circle A Construction	Prim. & 2ndry Crushing	S15 T42N R62E	2080	200.00	58.42	--	--	--
7	Circle A Construction	Prim. & 2ndry Crushing	S01 T42N R63E	4200	200.00	58.42	--	--	--
8	Circle A Construction[b]	Land Disturbance	S02 T42N R63E	8760	599.00	56.80	--	--	--
9	Circle A Construction	Dryer	S08 T37N R63E	1560	30.00	39.90	--	--	--
10	Claridge & Evans[b]	Land Disturbance	S17 T34N R55E	8760	20.00	56.80	--	--	--
11	Claridge & Evans[b]	Land Disturbance	S17 T34N R55E	8760	9.80	32.22	--	--	--
12	Continental Lime	Primary Crusher	S14 T34N R68E	8760	250.00	7.01	--	--	--
13	Continental Lime	Stacker	S14 T34N R68E	8760	67.67	0.42	--	--	--
14	Continental Lime	Stone Dressing Screen	S14 T34N R68E	8760	33.33	0.49	--	--	--
15	Continental Lime	Coal Handling System	S14 T34N R68E	8760	3.70	0.26	--	--	--
16	Continental Lime	Kiln	S14 T34N R68E	8760	16.67	10.01	7.36	46.68	33.36
17	Continental Lime	Final Prim. Crushing	S14 T34N R68E	8760	16.67	2.20	--	--	--
18	Continental Lime	Lime Silo	S14 T34N R68E	8760	0.00	0.02	--	--	--
19	Continental Lime	Two Lime Silos	S14 T34N R68E	8760	16.67	0.02	--	--	--
20	Continental Lime[b]	Land Disturbance	S14 T34N R68E	8760	147.00	56.80	--	--	--
21	Elko General Hospital	Incinerator	S15 T34N R55E	2000	0.08	0.22	0.31	0.29	0.00
22	Elko General Hospital	Boiler	S15 T34N R55E	8760	12.60	2.65	4.88	4.62	0.00
23	Harney Rock & RVG	Prim. & 2ndry Crushing	S16 T34N R56E	1350	190.00	56.76	--	--	--
24	Humboldt Readymix	Concrete Batch Plant	S13 T34N R55E	2080	300.00	45.50	--	--	--
25	J. Equipment	Concrete Batch Plant	S09 T37N R62E	1440	16.00	26.23	--	--	--
26	Silver Smith Casino	Boiler	S15 T33N R70E	8760	7.07	4.23	2.74	2.59	0.15
27	Silver Smith Casino	Boiler	S15 T33N R70E	8760	7.07	4.23	2.74	2.59	0.15
28	Silver State Rock	Concrete Batch Plant	S21 T35N R56E	2000	300.00	62.83	--	--	--
29	Stateline Hotel	Boiler	S15 T33N R70E	8760	4.20	6.17	5.91	1.54	0.40
30	Stateline Hotel	Boiler	S15 T33N R55E	8760	6.40	8.60	9.04	0.99	0.00
31	Stockmen's Hotel	Boiler	S15 T34N R55E	8760	10.50	10.49	14.71	2.40	0.75
32	Toano Corporation[b]	Land Disturbance	S17 T33N R70E	8760	1260.80	56.80	--	--	--
33	Vega D & H	Secondary Crushing	S03 T35N R57E	1760	80.00	48.96	--	--	--
34	Vogue Laundry	Two Boilers	S15 T34N R55E	2600	16.70	4.23	11.66	0.11	0.15

Source: NDEP 1989; Woodward-Clyde Consultants

[a] Capacity = MMBtu/hr for boilers and other combustion sources
= Tons/hr for all others, except land disturbances
= Acres distrubed for land disturbance sources

[b] TSP emissions from land disturbances estimated using emission factor of 1.2 tons/acre-month (EPA 1985), with an assumed upper limit of 249 tons/yr, since sources are not PSD sources.

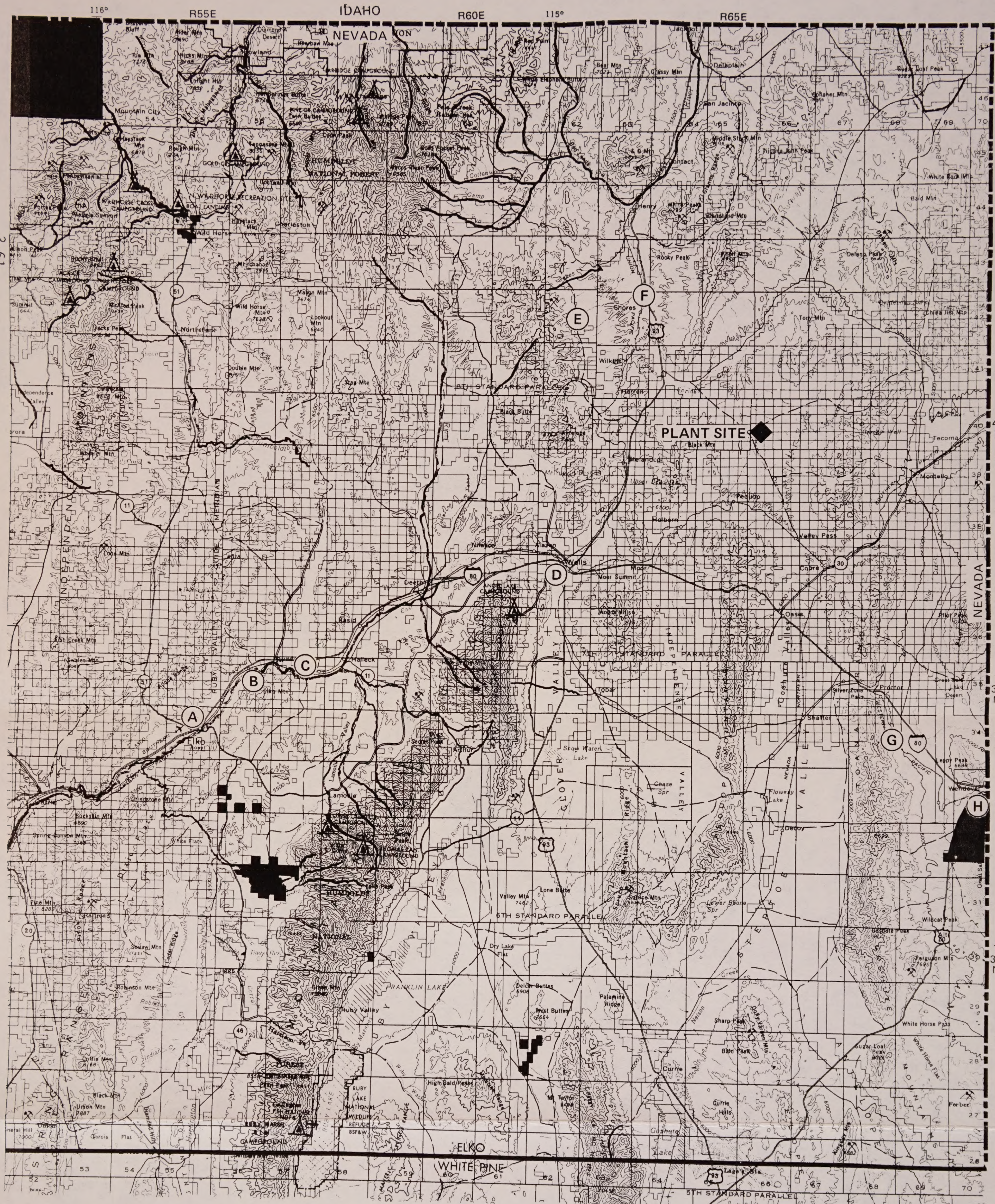
Table 3-16. EMISSION INVENTORY OF PERMITTED SOURCES WITHIN 100 KILOMETERS OF TSPP SITE (ANNUAL EMISSIONS)

Source Number	Company	Source Type	Location	Hours of Operation Per Year	Capacity[a]	TSP (tons/yr)	SO_2 (tons/yr)	NO_x (tons/yr)	CO (tons/yr)
1	Agriculture, Dept. of	Incinerator	S10 T34N R55E	600	0.08	0.1	0.1	0.1	0.0
2	Barrick	Autoclave	S09 T34N R55E	8760	73.50	2.2	124.7	118.0	0.0
3	Barrick	Boiler	S09 T34N R55E	8760	51.59	1.1	158.2	31.1	7.9
4	Barrick	Lime Silo	S09 T34N R55E	8760	5.74	1.1	--	--	--
5	Burns Funeral Home	Incinerator	S10 T34N R55E	2080	0.05	0.5	0.3	0.3	0.0
6	Circle A Construction	Prim. & 2ndry Crushing	S15 T42N R62E	2080	200.00	60.8	--	--	--
7	Circle A Construction	Prim. & 2ndry Crushing	S01 T42N R63E	4200	200.00	122.7	--	--	--
8	Circle A Construction[b]	Land Disturbance	S02 T42N R63E	8760	599.00	249.0	--	--	--
9	Circle A Construction	Dryer	S08 T37N R63E	1560	30.00	31.1	--	--	--
10	Claridge & Evans[b]	Land Disturbance	S17 T34N R55E	8760	20.00	249.0	--	--	--
11	Claridge & Evans[b]	Land Disturbance	S17 T34N R55E	8760	9.80	141.1	--	--	--
12	Continental Lime	Primary Crusher	S14 T34N R68E	8760	250.00	30.7	--	--	--
13	Continental Lime	Stacker	S14 T34N R68E	8760	67.67	1.8	--	--	--
14	Continental Lime	Stone Dressing Screen	S14 T34N R68E	8760	33.33	2.1	--	--	--
15	Continental Lime	Coal Handling System	S14 T34N R68E	8760	3.70	1.2	--	--	--
16	Continental Lime	Kiln	S14 T34N R68E	8760	16.67	43.8	32.3	204.5	146.1
17	Continental Lime	Final Prim. Crushing	S14 T34N R68E	8760	16.67	9.7	--	--	--
18	Continental Lime	Lime Silo	S14 T34N R68E	8760	0.00	0.1	--	--	--
19	Continental Lime	Two Lime Silos	S14 T34N R68E	8760	16.67	0.1	--	--	--
20	Continental Lime[b]	Land Disturbance	S14 T34N R68E	8760	147.00	249.0	--	--	--
21	Elko General Hospital	Incinerator	S15 T34N R55E	2000	0.08	0.2	0.3	0.3	0.0
22	Elko General Hospital	Boiler	S15 T34N R55E	8760	12.60	11.6	21.4	20.2	0.0
23	Harney Rock & RVG	Prim. & 2ndry Crushing	S16 T34N R56E	1350	190.00	39.0	--	--	--
24	Humboldt Readymix	Concrete Batch Plant	S13 T34N R55E	2080	300.00	47.3	--	--	--
25	J. Equipment	Concrete Batch Plant	S09 T37N R62E	1440	16.00	18.9	--	--	--
26	Silver Smith Casino	Boiler	S15 T33N R70E	8760	7.07	18.5	12.0	11.3	0.7
27	Silver Smith Casino	Boiler	S15 T33N R70E	8760	7.07	18.6	12.0	11.3	0.7
28	Silver State Rock	Concrete Batch Plant	S21 T35N R56E	2000	300.00	62.8	--	--	--
29	Stateline Hotel	Boiler	S15 T33N R70E	8760	4.20	27.0	25.9	6.7	1.7
30	Stateline Hotel	Boiler	S15 T33N R55E	8760	6.40	37.7	39.6	4.3	0.0
31	Stockmen's Hotel	Boiler	S15 T34N R55E	8760	10.50	46.0	64.4	10.5	3.3
32	Toano Corporation[b]	Land Disturbance	S17 T33N R70E	8760	1260.80	249.0	--	--	--
33	Vega D & H	Secondary Crushing	S03 T35N R57E	1760	80.00	43.1	--	--	--
34	Vogue Laundry	Two Boilers	S15 T34N R55E	2600	16.70	5.5	15.2	0.1	0.2

Source: NDEP 1989; Woodward-Clyde Consultants

[a] Capacity = MMBtu/hr for boilers and other combustion sources
= Tons/hr for all others, except land disturbances
= Acres distrubed for land disturbance sources

[b] TSP emissions from land disturbances estimated using emission factor of 1.2 tons/acre-month (EPA 1985), with an assumed upper limit of 249 tons/yr, since sources are not PSD sources.



LEGEND

Location	Source Numbers
Ⓐ	1-5. 10, 11, 21-24, 31, 34
Ⓑ	16, 28
Ⓒ	33
Ⓓ	9, 25
Ⓔ	6
Ⓕ	7, 8
Ⓖ	12-20
Ⓗ	26, 27, 29, 30, 32

Source: Woodward-Clyde Consultants 1989.

0 10 20
miles

N

Figure 3-26. LOCATIONS OF SOURCES IN MINOR SOURCE INVENTORY

in the Elko Fire District (BLM 1989b) and emission factors for wildfires and prescribed burning (EPA 1988b) were used. Since the types of vegetation burned and fuel loading were unknown, and presumably varied, a range of fuel loadings was assumed, from a minimum of 35,000 lbs/acre to a maximum of 55,000 lbs/acre. In addition, since PM_{10} emissions were of concern, it was assumed that 80 percent of the PM generated from these fires was in the form of PM_{10}. Table 3-17 provides the results of these computations for 1978 to 1988. Estimated PM_{10} emissions range from a low of 149 tons/yr to a high of 37,427 tons/yr, depending on the year being evaluated and the assumed fuel loading.

The NDEP issues permits for prescribed burning. These permits are issued to local fire districts, who in turn are responsible for managing the permits. The permits only allow burning during certain times of the year and then only on prescribed burn days.

3.6 GLOBAL WARMING ("GREENHOUSE EFFECT")

Global warming caused by increases in atmospheric concentrations of "greenhouse" gases has recently become a major scientific and political issue. In simplified terms, the earth's temperature represents a balance between incoming solar radiation (energy in the ultraviolet, visible, and near-infrared wavelengths) and outgoing heat (long-wavelength infrared radiation). Since certain atmospheric gases, principally water vapor and carbon dioxide (CO_2) retain heat, outgoing radiation is trapped and global temperature increases. Other gases that also influence this balance include methane, chlorofluorocarbons, nitrous oxide, tropospheric (lower atmosphere) ozone, and several other trace gases (EPRI 1988). Figure 3-27 shows the estimated relative contributions of gases (excluding water vapor) to the greenhouse effect. From 1880 to 1980, CO_2 comprised approximately 66 percent of the gases thought to influence global increases in temperature, although during the 1980s its contribution decreased to 49 percent.

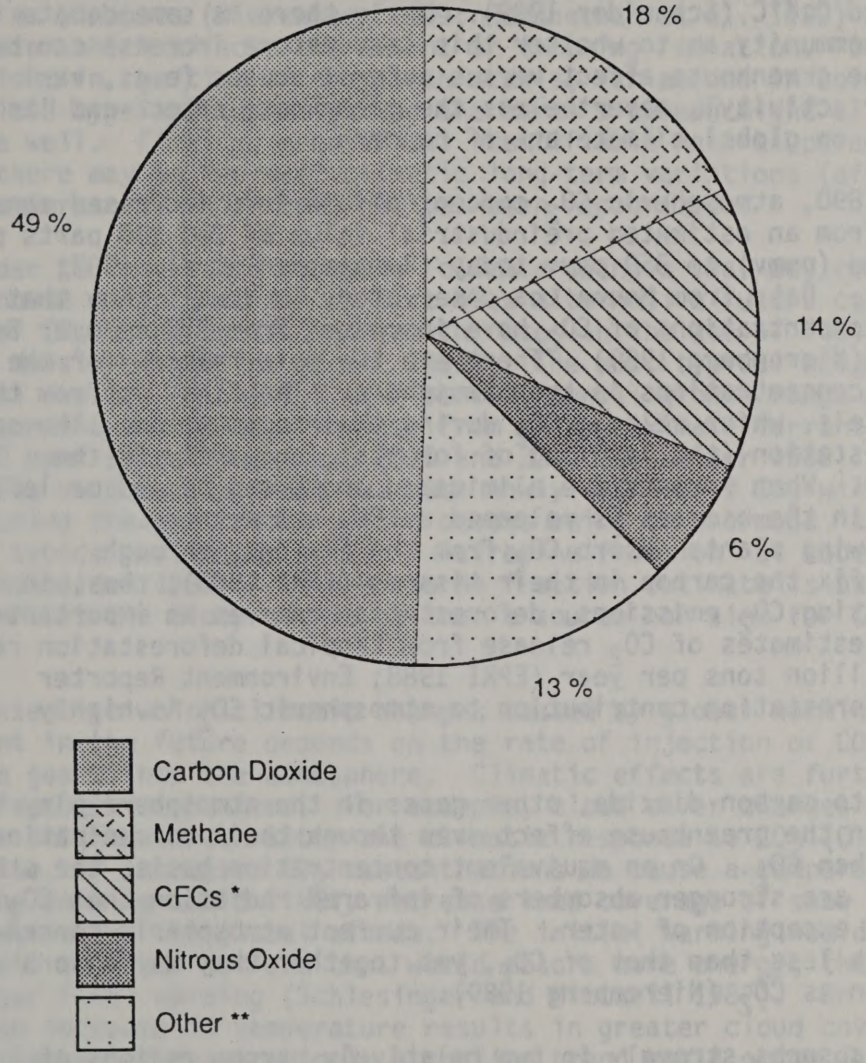
Much of the incoming ultraviolet energy is absorbed by the stratosphere (upper atmosphere), principally by nitrogen, oxygen, and ozone. There is little absorption of the visible and near-infrared wavelengths in the atmosphere. Owing to the relatively low albedo (reflectivity) of the earth's surface, most of the incoming radiation is absorbed by the surface compared to that reflected back to the atmosphere. The absorbed radiation results in an increase in the earth's surface temperature with a corresponding reradiation in the longer-wavelength infrared range. Because the greenhouse gases absorb infrared radiation more efficiently than shorter wavelength radiation, much of this longer wavelength radiation does not escape into space. Thus, the air and, subsequently, the earth's surfaces are warmer than they would otherwise be in the absence of the greenhouse gases. Increases in concentrations of atmospheric gases that absorb infrared radiation could result in additional atmospheric heating (Perhac 1988). The typical analogy used to describe the above is the effect of the glass roof and walls of a greenhouse, allowing sunlight to penetrate but preventing infrared (heat) from escaping.

Table 3-17. NUMBER OF ACRES BURNED IN ELKO FIRE DISTRICT (1978-1988) AND ESTIMATED PM_{10} EMISSIONS

Year	Total Acres	PM_{10} Emissions[a] (tons/yr)[b]	(tons/yr)[c]
1978	1250	148.8	233.8
1979	66366	7897.6	12410.4
1980	6728	800.6	1258.1
1981	24395	2903.0	4561.9
1982	835	99.4	156.1
1983	13719	1632.6	2565.5
1984	78258	9312.7	14634.2
1985	200144	23817.1	37426.9
1986	29721	3536.8	5557.8
1987	17490	2081.3	3270.6
1988	22728	2704.6	4250.1

Sources: BLM 1989b; Woodward-Clyde Consultants

[a] PM_{10} emissions estimated using AP-42 emission factor (EPA 1988)
[b] Assumed fuel loading of 35,000 lbs/acre
[c] Assumed fuel loading of 55,000 lbs/acre



Note: Water vapor not included

* CFC-11 and CFC-12.

** Tropospheric ozone and other halocarbons.

Source: Machado and Piltz 1988.

Figure 3-27. ESTIMATED RELATIVE CONTRIBUTIONS TO THE GREENHOUSE EFFECT IN THE 1980s

Over the past century, the mean global temperature has been estimated to have increased 0.5°C (Schneider 1989). While there is some debate in the scientific community as to whether this temperature increase can be attributed to the greenhouse effect versus natural causes (e.g., variability in solar activity), nevertheless the greenhouse effect and its potential effect on global climate are of concern.

Since 1850-1890, atmospheric CO_2 concentrations have increased about 20 to 25 percent, from an estimated preindustrial value of 280-290 parts per million by volume (ppmv) to 350 ppmv today (Ramanathan et al. 1987; Nierenberg 1989). Data from Mauna Loa observatory in Hawaii show that annual average concentrations of CO_2 have increased from 310 to over 340 ppmv since 1958 (Nierenberg 1989). There are two main reasons for the increase in CO_2 concentrations in the atmosphere. The first is from the use of fossil fuels, which release CO_2 during their combustion. The second is due to deforestation (the leveling of forests), primarily in the tropical regions. When forests are eliminated and trees burned or left to rot, the carbon in the biomass is released as CO_2 and methane. In addition, growing plants absorb CO_2 from the air and, through photosynthesis, fix the carbon in their tissues (EPRI 1988); thus, in addition to creating CO_2 emissions, deforestation removes an important CO_2 "sink". Recent estimates of CO_2 release from tropical deforestation range from 0.4 to 3 billion tons per year (EPRI 1988; Environment Reporter 1988b). The deforestation contribution to atmospheric CO_2 is highly uncertain.

In addition to carbon dioxide, other gases in the atmosphere play an important role in the greenhouse effect even though their concentrations are much lower than CO_2. On an equivalent concentration basis, the other greenhouse gases are stronger absorbers of infrared radiation than CO_2 (EPA 1988e), with the exception of water. Their current atmospheric concentrations are much less than that of CO_2, yet together they may absorb about as much radiation as CO_2 (Nierenberg 1989).

Whereas CO_2 absorbs strongly in two relatively narrow regions of infrared radiation, water vapor absorbs strongly at almost all infrared wavelengths (Fleagle and Businger 1980; Wallace and Hobbs 1977). Since the average water vapor concentration in the earth's atmosphere is about 0.75 percent (7500 ppmv), it is by far the greatest contributor to the total heat content of the earth's surface. However, owing to the large fluctuations in global water vapor concentrations, it has not been possible to establish any concentration changes versus time correlation. Therefore, predictive calculations (models) of temperature increase from greenhouse gases typically assume that the water vapor concentration is constant and does not contribute to any increase in global temperature; however, some models try to account for water droplets in the form of clouds.

As mentioned above, increases in global temperature may not be entirely attributable to increases in CO_2 concentrations. There are a number of factors that may also have an effect on global temperature. For example, the sun's radiation is nearly but not quite constant, depending on such variables as sunspots (Nierenberg 1989; Ramanathan et al. 1989) and solar disc diameter which affects the amount of incoming radiation. Small perturbations in the tilt of the earth's axis, variations in volcanic activity, cloud type and quantity, and the earth's albedo might all contribute as well. Finally, even if all identifiable natural parameters were constant there may be "normal" climatic long-term variations (affecting earth's temperature) which have not yet been recognized.

In order to understand potential climate changes that may result from the greenhouse effect, scenarios that show alternative future concentrations of CO_2 based on assumed growth rates in the use of fossil fuels have been developed (Lovins et al. 1981). The most typical projections of fossil fuel use are in the 0.5 to 2 percent annual growth range and imply that CO_2 concentrations may increase from an approximate current level of 350 to 600 ppmv sometime between 2030 and 2080 (Schneider 1989). There is considerable uncertainty about how much newly introduced CO_2 will remain in the air during the next century (the oceans being an enormous "sink" for CO_2), but typical estimates put this "airborne fraction" at about 50 percent (Schneider 1989). This airborne fraction estimate is based on the assumption that the biosphere is neither a source nor sink for CO_2 (Perhac 1989).

The extent to which climatic changes caused by global warming may prove significant in the future depends on the rate of injection of CO_2 and other greenhouse gases into the atmosphere. Climatic effects are further complicated by feedback mechanisms. For example, cloud cover changes in amount, height, or brightness can alter the climatic response to CO_2 (Clark 1982). Also, if increased CO_2 concentrations do cause a temperature increase, the warming would likely decrease land coverage of snow and ice, thereby decreasing the global albedo. The initial warming would, therefore, create a darker surface that would absorb more energy, thereby creating a larger final warming (Schlesinger and Mitchell 1987). On the other hand, if an increase in temperature results in greater cloud cover (as a result of increased evaporation), a cooling trend could occur. Current models do not handle this component effectively (Nierenberg 1989). Because feedback mechanisms interact in the climatic system, estimating global temperature increase is difficult. Projections of a global mean temperature response to an increase of CO_2 concentration from 300 to 600 ppmv vary from 2.0 to 5.0°C (Stone et al. 1988).

Climatic changes and corresponding global impacts as a result of significant warming of the earth's atmosphere are difficult to postulate. It is also very difficult to predict the location and magnitude of the potential effects of greenhouse warming on a particular region. The Global Climate Models (GCM) currently being used are mainly sensitive to large scale and seasonal changes only (Schneider 1989; EPRI 1988). A possible scenario is that the arid regions of the western U.S. could become hotter and drier if global mean temperature increased 3°C (Schneider 1989). Also, possible altered patterns of precipitation and evaporation could shift agriculturally productive areas. These changes could produce detrimental as well as beneficial conditions depending on geographical location.

Current estimates of global carbon emissions from fossil fuel combustion are about 5 billion metric tons per year (18 billion metric tons of CO_2 (EPRI 1988). Carbon emissions from fossil fuel combustion in the U.S. during 1986 have been estimated as 1.3 billion metric tons (4.7 billion metric tons of CO_2). Table 3-18 provides estimates of the 1986 carbon emissions from fossil fuel combustion in the western U.S. These emission estimates are solely for fossil fuel combustion and do not account for emissions from other industrial sources or natural sources. For example, a natural gas processing project proposed in 1983 in Wyoming (BLM 1983) would emit to the atmosphere about 36.5 million metric tons of CO_2 per year while processing approximately 2800 million standard cubic feet per day of "sour" natural gas.

Annual global emission projections of carbon from fossil fuel combustion for 2050 range from 5 to 25 billion metric tons (18 to 92 billion metric tons of CO_2) (National Resources Council 1983; Keppin et al. 1986). These estimates based on the projected usage of energy resources by several investigators demonstrate the wide range of uncertainty in predicting CO_2 emissions. Future CO_2 emissions will be greatly dependent on the economy of controls, future legislation, the degree of use of CO_2 emission controls, and increased usage of other power production methods (e.g., nuclear power). Again, as with current estimates of CO_2 emissions, these emission projections are from fossil fuel combustion and do not include loss of CO_2 "sinks" of wood combustion resulting from tropical deforestation. Because there are currently no good estimates for natural emissions of CO_2, they are not included in these projections.

Table 3-18. ESTIMATED 1986 CARBON EMISSIONS (MILLION METRIC TONS) FROM FOSSIL FUEL COMBUSTION IN THE WESTERN UNITED STATES AND TOTAL FOR UNITED STATES

State	Total Carbon Emissions
Arizona	15.16
California	85.23
Colorado	16.53
Idaho	2.73
Montana	6.32
Nevada	7.25
New Mexico	12.01
Oregon	7.28
Utah	9.88
Washington	16.20
Wyoming	11.63
Total	190.22
Total United States	1275.30

Source: Machado and Piltz 1988

Note: One ton of carbon is equivalent to 44/12 tons of carbon dioxide

4.0

ENVIRONMENTAL CONSEQUENCES

The purpose of this section is to describe potential environmental impacts for the three components (land acquisition, construction, and operation) of the proposed action and alternatives. Specifically, this section describes the assumptions and assessment guidelines used in analyzing the environmental consequences, and the potential direct and indirect air quality impacts of the proposed action and alternatives on the environment. Potential air quality impacts to resources were analyzed only for those alternatives which could be expected to have an effect on that resource.

Air quality analyses were conducted to evaluate potential environmental impacts from the construction and operation of the proposed Thousand Springs Power Plant (TSPP). Air quality issues of concern are briefly described below and discussed in more detail in subsequent sections.

During construction phases, concern for air quality involves pollutant emissions from combustion engines and fugitive dust generated during construction-related activities. Fugitive dust emissions could also occur by wind erosion of exposed soil surfaces and machinery/vehicle activity.

Potential impacts as a consequence of plant operation include increased ambient air concentrations from gaseous and particulate emissions from boiler stacks due to coal combustion; effects on visibility from boiler stack emissions; particulate emissions from cooling tower drift (dissolved chemicals in the drift water droplets that solidify upon evaporation); and fugitive particulate matter (PM) emissions from storage, handling, and conveyance operations involving coal, ash, and lime.

In addition to the above, during plant operation, sulfur dioxide (SO_2) and nitrogen oxides (NO_x) emissions could affect air quality related values (AQRVs) in Class I areas in the region. The air quality related values that could be affected include visibility, water, flora, and fauna. Associated with potential impacts on AQRVs are the effects from acid deposition. Possible impacts from acid deposition in regional Class I areas, other wilderness areas, and wilderness study areas are also addressed.

Recently, there has been increased concern over potential effects from emissions of carbon dioxide into the atmosphere due to the combustion of fossil fuels on global climate change. Global warming and increased emissions of carbon dioxide from the TSPP are discussed.

4.1 CONSTRUCTION EMISSIONS AND IMPACTS

Construction of the proposed TSPP would occur in intermittent phases over a 20-year period. Initially, during the first phase of construction, access and haul roads to the proposed site would be prepared. Once access to the site was obtained, the first 250-megawatt (MW) generating unit and ancillary facilities would be constructed. Thereafter, at approximately 2-year intervals, additional generating units would be constructed. This process would continue over a 20-year period until at full scale operation, eight 250-MW units would be in place (see Section 1.0 for further details).

Total disturbed acreage would be approximately 1780 acres. The majority of this acreage would be used for coal stockpiling, solid waste disposal, and wastewater evaporation ponds. Construction of these areas would occur intermittently over 20 years.

Air pollutant emissions from site construction activities would primarily be from:

- Fugitive particulate emissions from landclearing, site preparation, and from vehicles and construction equipment traveling over unpaved areas
- Fugitive particulate emissions from wind erosion of exposed areas
- Engine exhaust emissions from operating heavy-duty diesel-powered and gasoline-powered construction equipment and vehicles

In addition, road paving work and painting would result in the release of some hydrocarbons. These emissions are not considered further in this analysis since they would be small, temporary, and insignificant.

Table 4-1 provides information on the total acreage of land disturbed during different project construction phases over the 20 year period, broken down by month and year, based on the proposed construction schedule. These acreages represent the actual areas that would be expected to be disturbed rather than the potential area (e.g., entire right-of-way). For example, it is assumed that for rail spur construction a 50-foot width would be disturbed rather than the entire right-of-way of 200 feet. It is expected that during construction, land disturbance activities would occur at most 5 days per week, 10 hours per day. The approximate number of acres worked per day for each of the different construction activities during construction of the first 250-MW unit are listed in Table 4-2. It is expected that during construction, land disturbance activities last 10 hours during the day, 5 days per week. Based on the information given in Table 4-2, the largest area to be disturbed in a day would be 1.4 acres, during access road construction. In general, the areas worked per day for

Table 4-1. APPROXIMATE MONTHLY AND ANNUAL ACREAGE OF LAND DISTURBED DURING CONSTRUCTION ACTIVITIES

Unit	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Monthly Maximum	Annual Total
1	1991	6.0	6.0	11.0	62.0	71.0	79.0	82.0	50.0	29.0	3.5	1.0	0.5	82.0	401
	1992	0.5	2.5	2.5	2.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	21.5	9
2	1993	0.0	0.0	0.0	4.0	4.5	10.5	13.5	11.5	10.0	3.5	1.0	0.5	13.5	59
	1994	0.5	2.5	2.5	2.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	2.5	9
3	1995	0.0	0.0	0.0	4.0	4.5	10.5	13.5	11.5	10.0	3.5	1.0	0.5	13.5	59
	1996	0.5	2.5	2.5	2.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	2.5	9
4	1997	0.0	0.0	0.0	4.0	4.5	10.5	13.5	11.5	10.0	3.5	1.0	0.5	13.5	59
	1998	0.5	2.5	2.5	2.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	2.5	9
5	1999	0.0	0.0	0.0	4.0	4.5	13.5	16.5	20.5	18.0	8.5	1.0	0.5	20.5	87
	2000	0.5	2.5	2.5	2.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	2.5	9
6	2001	0.0	0.0	0.0	4.0	4.5	10.5	13.5	11.5	10.0	3.5	1.0	0.5	13.5	59
	2002	0.5	2.5	2.5	2.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	2.5	9
7	2003	0.0	0.0	0.0	4.0	4.5	10.5	13.5	11.5	10.0	3.5	1.0	0.5	13.5	59
	2004	0.5	2.5	2.5	2.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	2.5	9
8	2005	0.0	0.0	0.0	4.0	4.5	10.5	13.5	11.5	10.0	3.5	1.0	0.5	13.5	59
	2006	0.5	2.5	2.5	2.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	2.5	9

Table 4-2. APPROXIMATE NUMBER OF ACRES WORKED PER DAY FOR DIFFERENT ACTIVITIES DURING CONSTRUCTION OF THE FIRST UNIT

Area	Area Worked (acres/day)
Access Road	1.4
Railroad Spur	0.5
Main Plant & Rel. Area	0.6
Railroad Loop	1.1
Construction Worker Camp	0.6
Switchyard	0.4
Roads (on-site)	0.2
Cooling Towers	0.4
Major Drainage Structure	0.1
Solid Waste Disposal	0.3
Sewage Lagoon	0.1
Evaporation Ponds	0.5
Laydown	0.3
Coal Run-off Pond	0.2
Coal Piles	0.4

the different construction activities would be less than this value. The average area worked per day per construction activity is about 0.5 acre. These construction activities do not necessarily occur concurrently or in the same location. Therefore, emissions from these activities would not all be concentrated in one area. Table 4-3 shows the acreages disturbed for different construction activities during construction of each 250-MW unit.

During the initial construction activities, the majority of the land would be disturbed in order to provide access roads to the facility and grade the site to its final elevation. After the initial land disturbance takes place (410 acres) and Unit 1 begins operation, the degree of land disturbance would be substantially reduced to a level of less than 15 percent of the initial land disturbance. Therefore, maximum construction generated air emissions and maximum plant generated emissions would not occur simultaneously.

During construction of Unit 5, the degree of land disturbance would be approximately 22 percent of the initial land disturbance, or about 96 acres, as additional site-clearing activities for the remaining four units are performed. The level of construction after completion of Unit 5 would then return to the same level as during construction of Units 2 through 4, about 68 acres per unit.

A variety of different types of construction equipment would be required for site preparation, access road and railroad spur construction, and landclearing during the initial construction phase. Equipment used would include the following:

Site Area and Main Access Road:

- 10 scrapers
- 4 push cats
- 5 bulldozers
- 3 compactors
- 2 water trucks
- 3 loaders

Outlying Area Railroad:

- 4 scrapers
- 2 push cats
- 2 bulldozers
- 2 compactors
- 1 water truck
- 1 loader

Additional maintenance equipment would be required to support the onsite construction activities (e.g., delivery trucks, haul trucks, and fuel-lube trucks). The primary airborne pollutants from construction activities

Table 4-3. ACREAGE OF LAND DISTURBED DURING DIFFERENT CONSTRUCTION ACTIVITIES FOR EACH UNIT

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Total
Access Road	120	--	--	--	--	--	--	--	120
Railroad Spur	60	--	--	--	--	--	--	--	60
Main Plant & Rel. Area	20	15	15	15	15	15	15	15	125
Railroad Loop	60	--	--	--	--	--	--	--	60
Construction Comp.	18	--	--	--	--	--	--	--	18
Switchyard	4	4	4	4	4	4	4	4	32
Roads (on-site)	14	3	3	3	3	3	3	3	35
Cooling Towers	6	6	6	6	6	6	6	6	48
Major Drainage Structure	5	--	--	--	--	--	--	--	5
Solid Waste Disposal	16	--	--	--	16	--	--	--	32
Sewage Lagoon	5	--	--	--	--	--	--	--	5
Evaporation Ponds	30	20	20	20	20	20	20	20	170
Laydown	30	10	10	10	10	10	10	10	100
Coal Run-off Pond	12	--	--	--	12	--	--	--	24
Coal Piles	10	10	10	10	10	10	10	10	80
TOTAL (acres)	410	68	68	68	96	68	68	68	914

would be particulates released during land clearing and site preparation activities.

When conditions are favorable for dust generation, dust control can be provided through appropriate measures to reduce off-site impacts as well as improve on-site working conditions. Methods to control dust include minimizing the area which is subject to disturbance at any one time, use of mulch or other temporary covers on exposed soil areas, and limiting the movement over exposed soil surfaces. During dry weather conditions, spraying water on unpaved areas subject to heavy construction vehicle traffic will help to control dust. Paved areas should also be kept clear of loose dirt that can be re-entrained into the air during vehicle passage.

Estimates of particulate emissions from land disturbance activities during construction of Units 1 through 8 are provided in Table 4-4. These emission estimates are provided on a monthly basis for each year that construction activity is scheduled. An emission factor of 1.2 tons/acre of construction per month of activity (EPA 1985) was used. This is a general emission factor that includes activities such as landclearing, earthmoving (cut and fill operations), truck haulage, and wind erosion. The maximum monthly particulate emissions were estimated to be 240.6 tons, occurring during the first year of construction.

Maximum 24-hour total suspended particulate matter (TSP) emissions from construction activities were estimated as 2.3 pounds/hour, based on an area of 1.4 acres and assuming 50 percent dust control would be achieved by watering. Emissions of particulate matter less than 10 μm (PM_{10}) would be less than this.

Fugitive dust impacts during construction activities were modeled using the EPA-approved ISCST air dispersion model. Maximum 24-hour particulate matter concentrations were computed for a construction area of 1.4 acres. The area was modeled assuming the emissions were evenly distributed over the entire 1.4-acre area. Concentrations were calculated at receptors placed at 100-meter intervals out to a distance of 1000 meters from the downwind edge of the construction area. Worst-case off-site impacts were modeled during unstable and neutral atmospheric conditions. Stable atmospheric conditions were not modeled since they normally occur during the evening hours when construction activities have ceased. Maximum 1-hour concentrations were modeled and a persistence factor of 0.4 was used to compute 24-hour average concentrations. The maximum 1-hour average concentration was 186.4 micrograms/cubic meter (μg/m^3), resulting in a maximum 24-hour average particulate matter concentration from construction activities of 74.4 μg/m^3. This 24-hour average concentration, when added to the on-site measured background TSP or PM_{10} concentrations (see Table 3-12), results in a total concentration of 119 μg/m^3 for TSP and 94.4 μg/m^3 for PM_{10}. Both these total concentrations are lower than the National Ambient Air Quality Standard (NAAQS) of 150 μg/m^3 for PM_{10} and the Nevada standard of 150 μg/m^3 for TSP.

Table 4-4. ESTIMATED PARTICULATE EMISSIONS FROM CONSTRUCTION ACTIVITIES (TONS)

Unit	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Monthly Maximum	Annual Total
1	1991	3.6	3.6	6.6	37.2	42.6	47.4	49.2	30.0	17.4	2.1	0.6	0.3	49.2	240.6
	1992	0.3	1.5	1.5	1.5	0.3	0.3	0	0.0	0	0	0	0	1.5	5.4
2	1993	0	0	0	2.4	2.7	6.3	8.1	6.9	6	2.1	0.6	0.3	8.1	35.4
	1994	0.3	1.5	1.5	1.5	0.3	0.3	0	0.0	0	0	0	0	1.5	5.4
3	1995	0	0	0	2.4	2.7	6.3	8.1	6.9	6	2.1	0.6	0.3	8.1	35.4
	1996	0.3	1.5	1.5	1.5	0.3	0.3	0	0.0	0	0	0	0	1.5	5.4
4	1997	0	0	0	2.4	2.7	6.3	8.1	6.9	6	2.1	0.6	0.3	8.1	35.4
	1998	0.3	1.5	1.5	1.5	0.3	0.3	0	0.0	0	0	0	0	1.5	5.4
5	1999	0	0	0	2.4	2.7	8.1	9.9	12.3	10.8	5.1	0.6	0.3	12.3	52.2
	2000	0.3	1.5	1.5	1.5	0.3	0.3	0	0.0	0	0	0	0	1.5	5.4
6	2001	0	0	0	2.4	2.7	6.3	8.1	6.9	6	2.1	0.6	0.3	8.1	35.4
	2002	0.3	1.5	1.5	1.5	0.3	0.3	0	0.0	0	0	0	0	1.5	5.4
7	2003	0	0	0	2.4	2.7	6.3	8.1	6.9	6	2.1	0.6	0.3	8.1	35.4
	2004	0.3	1.5	1.5	1.5	0.3	0.3	0	0.0	0	0	0	0	1.5	5.4
8	2005	0	0	0	2.4	2.7	6.3	8.1	6.9	6	2.1	0.6	0.3	8.1	35.4
	1994	0.3	1.5	1.5	1.5	0.3	0.3	0	0.0	0	0	0	0	1.5	5.4

Note: Emissions are based on 1.2 tons/acre/month (EPA 1985) for each acre disturbed, assuming 50 percent dust control using watering.

Fugitive particulate emissions from land disturbance activities would primarily be ground-level ambient releases and of short-term duration at any given location, impacts would be temporary, transient, and localized in nature, and would not have a significant impact on long-term local or regional air quality. Fugitive dust emissions from unpaved haul or access roads would be controlled by water, or other approved methods. Additionally, other work areas where fugitive dust would be generated would be controlled by water, where practical.

Exhaust emissions associated with construction equipment operation are composed of the primary fuel combustion byproducts: NO_x, carbon monoxide (CO), PM, hydrocarbons (HC), and a small percentage of sulfur oxide (SO_x) compounds. Emission rates from construction equipment would depend on the level of construction activity and types of equipment used. With the level of equipment operating on site, spread out over a large area, exhaust emissions will not be concentrated in any given area and should not result in violations of any state or federal ambient air quality standards for any of the pollutants emitted. Therefore, these emissions would be insignificant and are not considered further in this analysis.

4.2 EMISSIONS RESULTING FROM PROJECT OPERATION

The major source of pollutant emissions during the operation of the proposed TSPP would result from the combustion of pulverized coal in the eight steam generators. Other emission sources include the coal-, ash-, and lime-handling facilities, cooling towers, and a fuel oil storage tank. Each of these sources are discussed in the following sections. A summary of estimated emissions from the entire proposed plant (all emission sources) is presented in Table 4-5.

4.2.1 Power Plant Stack Emissions

Air pollutant emissions associated with operation of the power plant would result primarily from fuel combustion. Each of the eight 250-MW units would be served by a separate stack. These units are proposed to become operational according to the following schedule:

- Unit 1 (1994)
- Unit 2 (1996)
- Unit 3 (1998)
- Unit 4 (2000)
- Unit 5 (2002)
- Unit 6 (2004)
- Unit 7 (2006)
- Unit 8 (2008)

Estimated air emissions of SO_2, NO_x, PM_{10}, and CO from the power plant stacks are given in Table 4-6. The table provides cumulative emissions as each 250-MW generating unit becomes operational. Maximum short-term (24 hours or less) emissions for each unit were calculated based on the currently proposed best available control technology (BACT) emission limits

Table 4-5. ESTIMATED CONTROLLED AIR EMISSIONS FROM THOUSAND SPRINGS POWER PLANT PROJECT

Source	Short-Term Maximum (lbs/hr)	Annual[a] (tons/yr)
Power Plant[b]		
Sulfur Dioxide	3,696	13,762
Oxides of Nitrogen[c]	9,241	34,405
Particulate Matter	314	1,171
Carbon Monoxide	2,384	8,876
Volatile Organic Compounds (VOCs)		
Methane	35.2	130
Nonmethane	82.4	305
Cooling Towers		
Particulate Matter	64.0	238.2
Chloroform	1.3	5.0
Coal-, Lime-, and Solid Waste-Handling		
Particulate Matter	37.1	64.5
Fuel Oil Storage		
Nonmethane VOCs	0.2	0.7

[a] Annual emissions based on an 85 percent load factor.

[b] Emissions of oxides of nitrogen, sulfur, and particulate matter from the power plant are based on current proposed control technologies of 0.45 lbs/MMBtu, 0.18 lbs/MMBtu, and 0.005 grains per actual cubic foot, respectively. Maximum heat input required for guaranteed turbine conditions at full load (2567 MMBtu/hr).

[c] As nitrogen dioxide.

Table 4-6. ESTIMATED CONTROLLED EMISSIONS FROM PROPOSED TSPP STACKS

	Number of 250-MW Units (Year Operational)							
	1 (1994)	2 (1996)	3 (1998)	4 (2000)	5 (2002)	6 (2004)	7 (2006)	8 (2008)
Maximum Short-Term (lb/hr)								
SO_2	462	924	1,386	1,848	2,310	2,772	3,234	3,696
NO_x	1,155	2,310	3,465	4,621	5,776	6,931	8,086	9,241
PM_{10}	39	79	118	157	197	236	275	314
CO	298	596	894	1,192	1,490	1,788	2,086	2,384
Annual Average[a] (tons/yr)								
SO_2	1,720	3,440	5,161	6,881	8,601	10,321	12,042	13,762
NO_x	4,301	8,601	12,902	17,202	21,503	25,804	30,104	34,405
PM_{10}	146	293	439	585	732	878	1,024	1,171
CO	1,109	2,219	3,328	4,438	5,547	6,657	7,766	8,876

[a] 85 percent Capacity factor applied for all years.

Note: (1) Expected plant capacity factors for each unit:

85 percent for years 1 through 10
80 percent for years 11 through 20
75 percent for years 21 through 35

(2) Emissions based on fuel heat input required for maximum guaranteed turbine conditions at full load (2567 MMBtu/hr)

for the first unit (see Section 4.4.1), a heat input to the boiler of 2567 million Btus per hour (MMBtu/hr) corresponding to turbine maximum guaranteed steamflow, and assuming 100 percent load (full load) with all equipment operating normally. Long-term emissions estimates were calculated assuming an average capacity factor of 85 percent over the plant life with all equipment operating normally. That is, the capacity factor reflects the fact that each 250-MW unit will not be operated 100 percent of the time due to downtime for inspection and maintenance, and that they will not be operating at full load 100 percent of the year. For each unit, the capacity factor is expected to decrease with age, with 85 percent expected for the first 10 years, decreasing to 75 percent for years 21 through 35.

As a conservative estimate of future emissions, the emission limits for Unit 1 based on the applicants proposed BACT were applied to all units. Realistically, overall plant emissions should be lower since this project is a phased construction project and the Prevention of Significant Deterioration (PSD) permit associated with this type of project requires that BACT be evaluated for each unit prior to its construction. This means that as control technology with increased efficiency becomes available it could be required for future units.

Coal for the TSPP is proposed to be supplied to the site from mines at Kemmerer, Wyoming (Kemmerer coal) and Scofield, Utah (Skyline coal). Coal from each mine would be blended for use in the boilers. This blended coal is considered the design basis or "Performance" coal and will be the basis for equipment specifications and manufacturers' guarantees. Each mine would supply coal in an amount approximately equal to 50 percent on a heating value basis. Coal would be delivered by rail. Table 4-7 provides analyses of the Kemmerer and Skyline coals, while Table 4-8 shows the typical characteristics of the Performance coal.

Because the emission limitations currently proposed as BACT for SO_2 are in terms of lbs SO_2/MMBtu of heat input, the maximum emissions are expected to vary only with changes in plant electrical load (i.e., fuel combustion rate). It would not vary with fuel type, as would emissions limitations with a specified SO_2 removal efficiency. In order to achieve the specified emission limit, the control equipment would have to operate at different efficiencies due to variation of sulfur content in the different coals. Approximate SO_2 control efficiencies based on the expected range of sulfur content for the Kemmerer, Skyline, and Performance coals are shown in Table 4-9. Control efficiencies range from a minimum of 77 percent for the minimum sulfur content of the Skyline coal to a maximum of 91 percent for the maximum sulfur content of the Kemmerer coal. On the average, using the Performance coal, a control efficiency of 87 percent would be achieved. Table 4-9 illustrates that by setting the emission limit in terms of pounds per million Btu rather than in terms of a percent removal, there is flexibility to use coal types of varying sulfur content. Whereas, if BACT were specified as a minimum percent SO_2, there would be less incentive to use low-sulfur coals since, for example, it is easier to remove 90 percent of the SO_2 from a higher sulfur coal than a lower one.

Table 4-7. BASIS OF DESIGN COAL AND ASH ANALYSES, THOUSAND SPRINGS PROJECT

	Pittsburg & Midway Kemmerer Mine		Coastal States Skyline Mine	
	Average	Range	Average	Range
Proximate Analysis				
Percent Moisture	21.0	19.0-23.0	10.0	8.0-13.0
Percent Ash	5.5	3.5-7.0	9.5	7.5-13.5
Percent Volatile	33.6	31.5-35.5	39.0	37.0-42.0
Percent Fixed Carbon	40.3	38.1-42.2	41.5	39.0-44.0
Btu	9800	9600-10,000	11,500	10,900-11,900
Percent Sulfur	0.8	0.6-1.0	0.65	0.45-0.8
Ultimate Analysis				
Percent Moisture	21.0	19.0-23.0	10.0	8.0-13.0
Percent Carbon	56.5	54.2-60.6	63.8	59.4-67.1
Percent Hydrogen	3.90	3.7-4.2	4.73	4.5-5.4
Percent Nitrogen	0.80	0.7-0.9	1.44	10.0-1.58
Percent Chlorine	0.01	0.0-0.0	0.02	0.0-0.05
Percent Sulfur	0.80	0.6-1.0	0.65	0.5-0.8
Percent Ash	5.5	3.5-7.0	9.50	7.5-13.5
Percent Oxygen	12.09	11.0-12.5	9.84	9.0-11.7
Hardgrove Grindability	60		48	43-50
Percent Equilibrium Moisture	19.2		NA	
Alkalies as Na_2O (dry coal)	0.1		NA	
Free Swelling Index	Nil		NA	
Ash Fusion Temperature (°F)				
	Reducing	Oxidizing	Reducing	Oxidizing
Initial Deformation	2250	2300	2100	2150
Softening (H=W)	2360	2380	2200	2250
Hemishperical (H=½W)	2375	2450	2250	2300
Fluid	2500	2575	2300	2350

Table 4-7. BASIS OF DESIGN COAL AND ASH ANALYSES, THOUSAND SPRINGS PROJECT (concluded)

	Pittsburg & Midway Kemmerer Mine		Coastal States Skyline Mine	
Mineral Analysis of Ash (Percent in ash)				
	Average	Range	Average	Range
Silica, SiO_2	46.9	42.0-52.0	57.0	50.0-61.5
Alumina, Al_2O_3	21.4	18.0-25.0	14.5	11.5-16.5
Titania, TiO^2	0.8	0.6-1.0	0.7	0.5-0.85
Ferric Oxide, Fe_2O_3	5.1	3.0-8.0	6.4	5.4-7.4
Lime, CaO	10.7	8.0-14.0	10.2	5.0-16.0
Magnesia, MgO	3.2	1.5-4.0	2.1	1.0-3.0
Potassium Oxide, K_2O	0.5	0.4-0.6	0.9	0.6-1.1
Sodium Oxide Na_2O	0.3	0.2-0.4	1.8	1.1-2.8
Sulfur Trioxide, SO_3	10.4	8.0-13.0	6.0	4.0-8.0
Phos. Pentoxide, P_2O	0.3	0.2-0.4	0.5	0.2-0.7
Lithium Oxide, Li_2O	0.0	0.0-0.0	--	---
Manganese Oxide, MnO	0.1	0.0-0.1	--	---
Undetermined	0.3	---	--	---

Table 4-8. TYPICAL PERFORMANCE COAL CHARACTERISTICS

Ultimate Analysis (As Fired)	Performance Coal
Percent Carbon	59.86
Percent Hydrogen	4.23
Percent Nitrogen	1.09
Percent Chlorine	0.02
Percent Sulfur	0.73
Percent Oxygen	11.05
Moisture	15.94
HHV Btu/lb	10,580

Table 4-9. APPROXIMATE SO_2 CONTROL EFFICIENCIES FOR DIFFERENT COAL TYPES

	Kemmerer Coal			Skyline Coal			Performance Coal
	Average	Min.	Max.	Average	Min.	Max.	Average
Btu/lb	9,800	--	--	11,500	--	--	10,580
Percent Sulfur	0.80	0.60	1.00	0.65	0.45	0.80	0.73
Uncontrolled Emissions per Unit (lb/hr)[a]	4,191	3,143	5,239	2,902	2,009	3,571	3,542
Percent Sulfur Dioxide Removal[b]	89	85	91	84	77	87	87

[a] Uncontrolled emissions are based on the average heating value and coal sulfur content, and a maximum heat input rating at full load of 2567 MMBtu/hr.

[b] Percent SO_2 removal calculated by dividing controlled emissions by uncontrolled emissions. Controlled emissions are based on 0.18 lb SO_2/MMBtu and a maximum heat input rating at full load of 2567 MMBtu/hr.

4.2.2 Coal-, Ash-, and Lime-Handling Emissions

Coal-handling operations within the power plant area would be conducted primarily using covered conveyor systems. Ash- and lime-handling operations would be conducted primarily using hydraulic and pneumatic conveyors.

Airborne PM would be generated during each of the handling operations involving coal, lime and solid waste (i.e., fly ash, and bottom ash). However, a high level of dust control would be provided in the design of the proposed TSPP, by venting emissions through a baghouse for those sources that could be contained or through the use of water spray on storage piles or open sources.

In order to evaluate the air quality impact from these emissions at full operation of TSPP, emissions from each of the individual activities were computed. Estimated controlled emissions from the coal-, lime-, and solid-waste handling operations are provided in Table 4-10. Emission rates were estimated based on methods outlined in the EPA's Compilation of Air Pollutant Emission Factors (EPA 1985, 1988b) or using engineering methods based on the design control efficiencies of the air pollution control equipment and material throughput. Short-term particulate emission rates (24-hours or less) were computed based on full operation of the proposed TSPP at capacity with all eight generating units on line. Long-term (annual) PM emission rates were based on an annual usage factor of 85 percent capacity per unit for the individual boiler coal silos and associated transfer stations and ash handling activities. However, the majority of the coal- and lime-handling activities would be operated at, or near, capacity during the arrival of new shipments and material transfer. During the remainder of the time, some emissions are not generated. Annual emissions from coal handling during railcar unloading and initial conveying and transfer to the active storage locations (coal storage silos or storage piles) were adjusted based on an annual usage factor of 60 percent capacity. Loading of the lime silos was assumed to occur 0.3 percent of the time (25 hours per year).

Emissions from rail car unloading operations and collecting transfer conveyors, which would not be vented through a baghouse, were computed using AP-42 emission factors (EPA 1985, 1988b). Water sprays would be used to control fugitive dust emissions from each source and were assumed to provide a 50 percent reduction in fugitive emissions. Emissions from the coal transfer silos, crushers and storage silos which would be vented through a baghouse were computed using engineering calculations. Emissions were based on a maximum design control emission rate of 0.01 grains per dry standard cubic foot of air vented through the baghouse when the unit is operating at full capacity. Long-term emission rates were adjusted based on a capacity factor of 85 or 60 percent based on the primary use of the equipment.

Active coal storage silos have been proposed to limit the level of activity and emissions within the dead coal storage piles during load-in and load-out operations. However, since the silos would not be constructed

Table 4-10. ESTIMATED EMISSIONS FROM COAL-, ASH-, AND LIME-HANDLING

Source Type	Particulate Emissions Short-Term Maximum (lbs/hr)	Particulate Emissions Long-Term (tons/yr)
Coal Silos, Transfer Towers, Crushers[a]	20.20	48.67
Coal Storage Piles[b]	12.82	8.19
Coal Unloading and Conveying[a]	0.67	1.77
Ash and Solid Waste Handling[b]	2.33	5.88
Lime Storage Silos[c]	1.10	0.01

[a] Assumed annual usage factors are 85 percent for coal silos and 60 percent for other transfer and handling operations.

[b] Calculated emissions assume dust generation by transfer and handling operations and by wind erosion. Wind erosion calculations assume a 20 m/sec windspeed for peak hour wind (based on conditions of maximum modeled concentration) and a 4.9 m/sec windspeed (annual windspeed) for annual emissions.

[c] Assumed annual usage factor is 0.3 percent (i.e., 25 hours per year).

until the third generating unit goes on line, maximum short-term emissions and air quality impacts were evaluated assuming active load-in and load-out operations into the coal piles for Unit 1 and 2. It was assumed that the majority of the activities within the pile would be confined to the area adjacent to the load-in stacker and reclaim conveyor during normal operations. The portion of the pile worked would be limited to approximately one-fourth of the pile, where equipment travel distances would be minimized, leaving the remaining portion of the pile inactive to minimize disturbance.

Short-term emissions during active coal pile load-out from the dead coal storage piles were computed using the AP-42 emission factors (EPA 1988b) derived from active storage pile activities. Emission controls were not applied during load-in and load-out activities because of difficulty in obtaining any substantial control with continuous disturbance of the coal pile, although during load-in operations a telescoping chute would be used, which should minimize emissions from this source.

Long-term emissions from the dead storage pile were computed using the AP-42 emission factors for wind blown emissions from coal storage piles. The total annual emissions from the pile were based on the level of available fine PM (which become released into the air during high winds) within the surface of the pile that may become airborne. Those portions of the pile which would remain undisturbed would have a limited reservoir of fines near the surface of the pile. As the majority of the fines are removed over time, the level of emissions would decrease.

As a conservative assumption, it was assumed that when all eight generating units were in operation the dead storage coal piles would be worked approximately five percent of the year, on the average, due to the delays in railcar shipments. Typically, coal would not be reclaimed from the dead storage piles once the line coal storage silos are in place. As identified previously, the portion of the pile worked would be limited to approximately one-fourth of the pile located closest to the stacker and reclaim conveyor, leaving the undisturbed portion of the pile inactive to minimize the generation of fine particles. Once the pile is disturbed, additional fines are generated which may later be released during high winds. Thus, portions of the pile which are disturbed have a higher annual emission rate than the undisturbed areas due to the higher concentration of fines on the pile surface that are subject to wind erosion. Emissions during active load-in and load-out were also averaged into the emission rates for the disturbed areas of the pile.

Chemical stabilizers would be used on the coal storage piles, as needed, to minimize emissions from wind erosion. The chemical stabilizers were assumed to provide 90 percent control of the fugitive emissions.

Fugitive PM emissions from the solid waste disposal area were computed using the same emission factors as were used for the active portions of the coal storage piles. Maximum short-term emissions were based on the volume of ash and lime spray dryer wastes generated with all eight generating units operating at full capacity. Since the material will be moist prior to disposal, the emissions during loading into haul trucks would be minimal. The release of airborne particulates would be generated primarily during covering of the material in the disposal area from both windblown emissions and emissions generated by earthmoving equipment. Long-term annual emissions, were based on the level of ash and lime spray dryer waste generated at 85 percent capacity of the plant. The portion of the disposal area disturbed on an annual basis was computed based on the volume of material disposed and assuming a total pile height of 20 feet. The area disturbed on a short-term basis was computed based on the volume of material disposed and assuming the pile height being worked at any one time would be limited to a height of 1 foot (i.e., material spread out over an area, to 1 foot in depth).

4.2.3 Cooling Towers

Cooling tower emissions consist primarily of water; however, progressive evaporation losses from the circulating water would concentrate dissolved solids up to 20 to 30 times their concentrations in the makeup water. The dissolved materials would be released as a mist from the cooling tower that would evaporate in the atmosphere and later be deposited as PM when the material settled out of the cooling tower plume. Thus, the cooling tower was included in the evaluation of airborne PM from the proposed TSPP. Estimated PM emissions from the cooling towers with all eight generating units in operation are presented in Table 4-5.

In addition, the cooling tower water would be treated with chlorine to prevent biological growth and slime buildup. The amount of chlorine added per cooling tower would be approximately 200 lbs/day. Disinfection would primarily occur from the formation of hypochlorite ions in the cooling tower water. These ions are nonvolatile; however, halogenated organic compounds could be formed in the cooling tower water, many of which are volatile, and thus, could be emitted to the atmosphere. According to a recent study by the Electric Power Research Institute (EPRI 1986), the only halogenated organics observed to be formed in chlorinated cooling tower water are trihalomethanes. This study indicates that up to 2 percent of the added chlorine may be converted to trihalomethanes, and that chloroform would constitute approximately half of these trihalomethanes. For the purpose of a conservative emissions estimate, it can be assumed that 2 percent of the added chlorine will be converted to trihalomethanes, all formed trihalomethanes will be emitted to the atmosphere, and chloroform will be the sole constituent in these emissions. Application of these assumptions yields the chloroform emission estimate given in Table 4-5.

In the assessment of atmospheric effects from power plants, one consideration is that of visible plume and cloud growth caused by emissions from cooling towers. Typical emissions from cooling towers include water, particulates, and heat. Cooling towers can emit as much as twice the energy generated for electricity (Hanna 1976). Typically, more than half of this "waste" energy is in the form of latent heat released to the atmosphere as the moisture plume evaporates. Thus, it is important to study the possible environmental effects of cooling towers in order to minimize environmental impact.

The moisture released into the atmosphere from mechanical draft cooling towers contains water droplets ranging from several microns (µm) in diameter up to several hundred µm in diameter. Water droplets with diameters up to 20 µm are considered fog; larger droplets (greater than 20 µm in diameter) are referred to as drift. The number of droplets in fog is quite large as compared to that of drift, and droplets consist of relatively pure water (Roffman 1975). In contrast to fog, the drift droplets contain essentially the same chemical concentrations as the circulating water.

Mechanical draft cooling towers are usually 20 to 30 meters in height. Thus, plumes are typically released at low elevations. A high degree of initial turbulence and momentum will dilute the plume with the surrounding environmental air. However, low buoyancy and potential building wake effects may result in a lower plume rise.

The visible fog plumes from a mechanical draft cooling tower can produce atmospheric effects such as ground fog, ice formation on surfaces, elevated visible plumes, cloud initiation, and augmentation of precipitation. The drift, which is deposited in the form of droplets or solid particulates, depending on atmospheric conditions, may leave precipitants of salts and various chemicals on surfaces downwind from the cooling towers (Roffman 1975).

Depending on the atmospheric conditions, vapor plumes can also contribute to local cloud formation. Precipitation and snow augmentation are possible as well. Owing to the lack of quantitative information regarding possible weather modifications by cooling systems, these factors were not included in this analysis.

Visible vapor plumes from the cooling towers at the proposed TSPP site were estimated using 20 years of temperature and wet-bulb temperature data from Ely, Nevada and from on-site wind data from the meteorological and air quality monitoring station at the proposed TSPP site (1981-1982).

The length of a visible plume extending from the cooling towers was calculated using the methods described by Hanna (1976), for different combinations of temperature and relative humidity. The temperature range was from 24°F (-4.4°C) to 72°F (22.2°C). Low temperatures, high relative humidities, low windspeeds, and stable atmospheric conditions all increase the chance of a long visible plume (Hanna 1976). The plume was assumed to be saturated when it leaves the tower. For this analysis, the mixing ratio of the initial cloud water and hydrometer water were both set equal to 0.001 grams of water per gram of air (g/g), on the basis that fog or clouds would be obviously present at the tower mouth; and the sum of the two, 0.002 g/g, is typical for natural cumulus clouds (Fletcher 1962). It was also assumed that the plumes from all the cells in the cooling tower bank combine, and the atmosphere is well-mixed.

Results show that for low relative humidities and high temperatures (summer), the visible plume length and height would be approximately 41 and 60 meters, respectively. During winter conditions characterized by low temperatures and high relative humidity (i.e., an almost saturated environment for a worst case analysis), the visible plume length and height were 488 and 269 meters, respectively. These worst-case winter-time plume dimensions are similar to those reported in a study of mechanical draft cooling tower plumes (during fall and winter) from the Potomac Electrical Power Company's Benning Road Generation Station (Meyer et al. 1975). Since these downwind distances are within or adjacent to plant boundaries, areas such as Highway 93 are sufficiently distant so that ground fog and icing should not be a problem.

Environmental effects of drift deposition on ground surfaces and vegetation from the cooling towers would be minimal except in the immediate vicinity of towers. Hanna et al. (1982) reported that drift deposition effects are at a maximum within 200 meters from the towers. Other investigators have reported observed maximum deposition to occur between 30 and 300 meters downwind (Alkezweeny et al. 1975), while Roffman and Gimble (1975) found that maximum daily deposition levels occurred within 330 meters downwind from the tower.

Combined Effects of Cooling Tower and Stack Emissions. Interaction between the cooling tower plume and SO_2 in the presence of a sufficiently large number of condensation nuclei could result in formation of acidic aerosols, the concentration of which would depend on the relative humidity and the nature of the condensation nuclei. For interaction times of several minutes, the amount of oxidation varies between 0.02 percent at about 77 percent relative humidity to about 5 percent at approximately 95 percent relative humidity (Johnstone and Moll 1960).

The degree of merging between the cooling tower vapor plume and the stack plumes depends on the wind direction and the effective height of the plumes. Complete merging could occur only when the cooling tower and the stack are aligned along one wind direction and the effective height of all the plumes is the same. The effective stack height of the cooling tower and stack plumes should never be the same because of differences in stack heights and plume rise.

4.2.4 Fuel Oil Storage

One 50,000-gallon diesel-fuel storage tank with a diameter of 24 feet and a height of 16 feet would service an auxiliary boiler and provide fuel for plant startups. The associated process piping would contain approximately two pumps, six valves, and 24 flanges. Working and breathing losses from the transfer and storage of diesel fuel were calculated using formulae given in AP-42 (EPA 1985). These calculations assumed a molecular weight of 130 lb/lb-mole for diesel fuel, a vapor pressure of 0.012 psia, a paint factor of 1.58, and a diurnal temperature change of 32° F. Fugitive losses from the associated pumps, valves, and flanges will also result in hydrocarbon emissions. Estimates of these emissions were calculated using emission factors from a synthetic organic manufacturing industry study. For diesel fuel, these factors are 0.047 lb/hr per pump, 0.00051 lb/hr per valve, and 0.0018 lb/hr per flange (EPA 1986a). The fuel oil storage emission calculations assumed 12 plant startups per year of 8 hours duration each (i.e., 220,000 gallons of fuel consumption). In addition, 2 weeks of auxiliary boiler operation were assumed (i.e., 150,000 gallons of fuel consumption). The resulting emission estimates are given in Table 4-5.

4.3 COMPLIANCE WITH REGULATIONS

4.3.1 Ambient Air Quality Standards

The federal Clean Air Act provides for the establishment of National Ambient Air Quality Standards (NAAQS) to protect public health and welfare and, in addition, the State of Nevada has established ambient air quality standards as stringent or more than the NAAQS, depending on the pollutant.

Air quality analyses conducted for the proposed project included dispersion modeling of emissions from the TSPP utilizing EPA-approved models (see Section 4.5.1). Emissions from the boiler stacks, from the coal-, lime-, and ash-handling operations (fugitive and point sources), and from the cooling towers were modeled. Table 4-11 provides the resulting worst-case maximum ground-level concentrations predicted from these analyses at full project buildout. These maximum concentration increases from TSPP, when added to the background concentrations (based on on-site monitoring data), can be compared to ambient air quality standards. The highest predicted concentration increases from the proposed TSPP were used since the Nevada air quality standards are not to be exceeded at any time. Short-term national standards allow one exceedance per year; thus, the second-highest predicted concentrations could be used when comparing modeling results against the national standards, which would be less stringent than using the highest predicted concentrations. Comparison of the total predicted concentrations for each pollutant with their respective NAAQS or Nevada ambient air quality standard show that the proposed TSPP project would not cause violations of any applicable air quality standard.

4.3.2 New Source Performance Standards (NSPS)

Under PSD requirements, the proposed project is required to install BACT. For the applicable pollutants, the proposed BACT limitations, presented in Section 4.4-1, are more stringent than the NSPS for coal-fired power plants given in Section 2.1.3.1. Therefore, the proposed TSPP would be in compliance with NSPS requirements.

4.3.3 Prevention of Significant Deterioration

In addition to complying with ambient air quality standards, the proposed project must also comply with PSD requirements. These include documentation that the proposed air pollution control system constitutes BACT;

Table 4-11. MAXIMUM PREDICTED GROUND-LEVEL CONCENTRATIONS FROM TSPP WITH EIGHT UNITS IN OPERATION ($\mu g/m^3$)

Pollutant and Averaging Period	TSPP[a]	Background[b]	Total	National Ambient Air Quality Standards (Primary)[c]	National Ambient Air Quality Standards (Secondary)[c]	Nevada Ambient Air Quality Standards[c]
Sulfur dioxide						
3-hour	610.3	44.0	654.3	--	1300	1300
24-hour	100.4	13.0	113.4	365	365	365
Annual	9.9	3.0	12.9	80	80	80
Total Suspended Particulate Matter						
24-hour	26.4	44.7	71.1	150[d]	150[d]	150[d]
Annual	6.5	16.6	23.1	50[d]	50[d]	75[d]
Oxides of Nitrogen						
Annual	24.8	2.0	26.8	100	100	100
Carbon Monoxide						
1-hour	728.9	1142.0[e]	1870.9	40,000	40,000	40,000
8-hour	270.3	1142.0[e]	1412.3	10,000	10,000	6,670

[a] Highest predicted short-term concentration used in analysis because short-term Nevada standards do not allow any exceedances at any time.

[b] Maximum measured sulfur dioxide and oxides of nitrogen concentrations at plant site from 1981 to 1982; Maximum measured TSP concentrations at plant site from 1988 to 1989; carbon monoxide not measured.

[c] Short-term national standards (24 hours or less) are not to be exceeded more than once per year. Short-term Nevada standards are not to be exceeded at any time.

[d] National ambient particulate standards are for particulate matter below 10 micrometers in diameter (PM_{10}), while Nevada ambient particulate standards are for total suspended particulate matter (TSP).

[e] Source: Johnson (1989).

an air quality impact analysis demonstrating that, along with the ambient air quality standards, allowable air quality increments will not be exceeded; and a demonstration of no adverse impact on AQRVs in Class I areas. The results of each of these analyses are summarized below for the proposed project.

4.3.3.1 Best Available Control Technology. The EPA PSD regulations require the installation of BACT if the emissions of any pollutant regulated under the Clean Air Act exceed certain "significant" levels, as defined in 40 CFR 52.21(b)(23)(i). In accordance with these regulations, the following pollutants from the proposed TSPP are subject to BACT requirements: SO_2, NO_x, PM, CO, lead, beryllium, mercury, fluorides, and sulfuric acid mist. An evaluation of alternative air pollution control technologies for the proposed TSPP was performed in a "Top-Down" fashion, as stipulated in recent EPA guidelines concerning BACT (EPA 1989a). That is, the most stringent control technology available for a similar source or source category was first identified for each pollutant. Then, for each pollutant, the "top" control technology was evaluated for its technical, energy, environmental, and economic feasibility with respect to the proposed project. If the top technology was concluded to result in unreasonable energy, environmental, or economic impacts on the proposed project, the next most stringent level of control was evaluated. This process continued until the control level under consideration could not be eliminated on any substantial technical, environmental, or economic basis.

The alternative control technology analysis resulted in the identification of proposed BACT levels for the TSPP project. It should be noted, however, that this analysis is not intended to be a complete BACT analysis. Such an analysis will be submitted with the proposed project's PSD permit application to the NDEP, and the authority to establish final BACT emission limitations is with the NDEP. The proposed emission limitations presented here are the applicant's current assessment of BACT for the proposed project. Also, as discussed below, BACT would be reviewed by the NDEP for each 250-MW unit prior to each unit's construction. Thus, the BACT levels currently being proposed are for the first 250-MW unit and represent the minimum degree of control that would be applied to subsequent units as they come on-line. BACT determinations for future units would consider any new or improved control technology as it becomes commercially available.

For the proposed TSPP project, BACT for NO_x emissions is proposed to be the use of "Low-NO_x" burners with combustion modifications, BACT for CO is proposed to be proper burner and combustion chamber design, BACT for SO_2 is proposed to be a lime spray-dryer (dry scrubber) followed by a baghouse (fabric filter system), BACT for PM is proposed to be a baghouse (fabric filter system), and BACT for all other pollutants is proposed to be the lime spray-dryer/baghouse system. Section 4.4 gives more details concerning the proposed control technologies and the specifically proposed BACT emission limitations.

4.3.3.2 Ambient Air Impact Analysis. As stated above in Section 4.3.1 and shown in Section 4.5.2.1, the proposed project is not expected to cause an exceedance of any ambient air quality standard. With respect to allowable air quality increments, the Nevada Department of Environmental Protection (NDEP) has confirmed for the proposed TSPP that ". . . there have been no PSD applications submitted in the proposed area to trigger the baseline date" (NDEP 1989a). The "baseline date" is the date after which existing air pollution sources in the area could consume increment. Since the baseline date has not been triggered for any pollutant in the vicinity of the proposed TSPP, the full amount of allowable air quality increments is available for the proposed TSPP.

The air quality increment analysis discussed in Section 4.5.2.2 shows the increment consumption for TSP and NO_2 to be within allowable limits for the proposed TSPP at full buildout with current BACT. For SO_2, the applicant has committed to the level of control necessary to project all applicable increments. The NDEP must approve of a demonstration of increment protection prior to issuance of a PSD permit.

4.3.3.3 Air Quality Related Values. The U.S. Forest Service (USFS) has identified the following AQRVs as being of potential concern in the vicinity of the proposed TSPP project: water, flora, fauna, and visibility (USFS 1989a). Sensitive receptors for each AQRV are lake alkalinity for water, lichens for flora, macrobiotic aquatic insects for fauna, and reduction in visibility (visual range) for visibility.

Air quality analyses were performed to assess potential impacts of the proposed TSPP on AQRVs in the Class I Jarbidge Wilderness Area, as well as Class II wilderness areas in the region. In addition, other Class I areas at further distances from Jarbidge Wilderness Area were evaluated for visibility and acid deposition effects. Potential effects from other air pollution sources in the vicinity were not included in these analyses because TSPP would be the first PSD source to locate in the region and effects from other minor sources in the region are already accounted for in the background monitoring data used in these analyses.

The AQRV analyses relied on the use of air quality and visibility model to conservatively project what impacts would occur. As discussed in Section 4.5.3, the projected impacts on AQRVs in the Class I Jarbidge Wilderness would be below the USFS-specified LACs. For other Class I areas beyond Jarbidge Wilderness, potential impacts on visibility and from acid deposition would not be significant when applying the Class I LAC criteria for Jarbidge Wilderness Area to these other areas.

For Wilderness Areas and Wilderness Study Areas in the Class II region within 100 km of the proposed TSPP site, screening analyses for visibility and acid deposition were performed and compared to the Class I LACs since there are no LACs for Class II areas (only compliance with ambient air quality standards and Class II increments is required). In all of these wilderness areas, projected visibility impacts would be less than the Class

I LAC of 5 percent visibility reduction. For all Class II wilderness areas, except Bluebell Wilderness Study Area and East Humboldt Wilderness Area, sulfate deposition would be less than the Class I LAC of 5 kg/ha-yr for Jarbidge Wilderness. East Humboldt Wilderness Area would also receive total depositional nitrogen in excess of the Class I Wilderness AQRV management guidelines (USFS 1989b) of 5 kg/ha-yr. Details of the AQRV analysis are provided in Section 4.5.3.

4.3.4 Other Nevada Air Quality Permitting Requirements

4.3.4.1 Criteria Air Pollutants. The proposed project is required to install BACT to fulfill PSD requirements. The levels of air pollution control currently proposed as BACT for the proposed TSPP project will meet the "criteria" air pollutant emission limitations contained in the Nevada Administrative Code, as described in Section 2.2.2.

4.3.4.2 Air Toxics. The Nevada Administrative Code (NAC) specifies control requirements for "toxic" air pollutants. For the proposed TSPP project, potential sources of toxic or hazardous air contaminant (THAC) emissions were identified, acceptable concentrations of toxic or hazardous air contaminants for the quality of ambient air (ACQAA) were computed per NAC requirements, maximum ground-level concentrations for each THAC in ambient air (off site) were computed and compared with the ACQAA, and best available control technology for toxics was assessed for those THACs emitted in amounts greater than 0.25 lbs/hr per 8-hour shift and exceeding the ACQAA without controls.

For this analysis, it was assumed that the main source of THACs would be the power plant stacks. Potential emissions of chloroform from the cooling towers as a result of chlorination of the cooling tower water were also considered. Other air emission sources at the proposed TSPP were considered minor emitters of potential THACs and not evaluated.

Potential THACs emitted from the power plant stacks were identified from the coal trace element analyses and from a review of literature. Potential THACs, categorized as either trace elements, organic pollutants, or radionuclides, are given in Table 4-12. Threshold Limit Values (TLVs) and ACQAAs are also shown in Table 4-12.

For the first category, trace elements, only those with TLVs were considered to be THACs. Emission rates for each trace element were estimated by first computing an emission factor (lb THAC/MMBtu), then multiplying this emission factor by the required boiler heat input rate at full load (2567 MMBtu/hr). The emission factors were derived using the average trace element concentrations in the coal and their heating values. This method assumes that all of the trace elements contained in the coal are emitted in the flue gas stream, a conservative assumption for many of the trace elements since typically 20 percent of the ash produced is bottom ash. Additionally, the highest average trace element concentration for either of the two coal types (Kemmerer and Skyline) was used in computing the emission factors. Table 4-13 provides the trace element emission factors

Table 4-12. THRESHOLD LIMIT VALUES (TLVs) AND ACCEPTABLE CONCENTRATIONS FOR THE QUALITY OF AMBIENT AIR (ACQAA) FOR POTENTIAL AIR CONTAMINANT EMISSIONS FROM THE THOUSAND SPRINGS POWER PLANT

Potential Air Contaminant	TLV[a] (mg/m^3)	ACQAA[b] ($\mu g/m^3$)
Trace Element		
Antimony	0.5	11.9
Arsenic	0.2	4.8
Barium	0.5	11.9
Beryllium	0.002	0.1
Bismuth	10	238.1
Boron	10	238.1
Bromine	0.7	16.7
Cadmium	0.05	1.2
Cerium	NA	NA
Cesium	2	47.6
Chlorine	3	71.4
Chromium		
metal/III	0.5	11.9
hexavalent (VI)	0.05	1.2
Cobalt	0.05	1.2
Copper		
* fume	0.2	4.8
dusts	1	23.8
Fluorides, as Fluoride	2.5	59.5
Gadolinium	NA	NA
Gallium	NA	NA
Germanium	0.6	14.3
Iodine	1	23.8
Lanthanum	NA	NA
Lead		
* dust	0.15	3.6
arsenate	0.15	3.6
chromate	0.05	1.2
Lithium (oxides)	NA	NA
Manganese		
dust	5	119.0
* fume	1	23.8
Mercury		
vapor	0.05	1.2
* alkyl	0.01	0.2
aryl and inorganic	0.1	2.4
Molybdenum		
* soluble	5	119.0
insoluble	10	238.1
Neodymium	NA	NA
Nickel		
metal	1	23.8
* soluble/carbonyl	0.1	2.4
Niobium	NA	NA
Phosphorus (oxides)	NA	NA

Table 4-12. THRESHOLD LIMIT VALUES (TLVs) AND ACCEPTABLE CONCENTRATIONS FOR THE QUALITY OF AMBIENT AIR (ACQAA) FOR POTENTIAL AIR CONTAMINANT EMISSIONS FROM THE THOUSAND SPRINGS POWER PLANT (concluded)

Potential Air Contaminant	TLV[a] (mg/m^3)	ACQAA[b] (μg/m^3)
Praseodymium	NA	NA
Rubidium	NA	NA
Samarium	NA	NA
Scandium	NA	NA
Selenium	0.2	4.8
Silver		
metal	0.1	2.4
* soluble	0.01	0.2
Sodium	5	119.1
Strontium	NA	NA
Tellerium	0.1	2.4
Terbium	NA	NA
Thorium	NA	NA
Tin		
metal/inorganic	2	47.6
* organic	0.1	2.4
Titanium	10	238.1
Uranium	0.2	4.8
Vanadium	0.05	1.2
Yttrium	1	23.8
Zinc		
* fume	5	119.1
dust	10	238.1
Zirconium	5	119.1
Organics		
Formalydehyde	1.5	35.7
Polycyclic Organic Matter as (B[a]P)	NA	NA
Cooling Towers		
Chloroform	50	1,190.5

* ACQAA selected from multiple forms.

[a] Based on TLVs for Chemical Substances in the Work Environment Adopted by American Conference of Governmental Industrial Hygienists (ACGIH), 1988-89.

[b] ACQAA = (TLV x 1000/42)

NA = Not Available

Table 4-13. EMISSION FACTORS, UNCONTROLLED EMISSIONS FOR EIGHT UNITS, MAXIMUM 8-HOUR MODELED CONCENTRATIONS, AND ACQAAs FOR TOXIC OR HAZARDOUS AIR CONTAMINANTS FROM TSPP

Toxic or Hazardous Air Contaminant	Average[a] Concentration in Coal (ppm)	Emission[b] Factor for Uncontrolled Emissions (lb/MMBtu)	Uncontrolled[c] Emissions (lb/hr)	Maximum 8-Hour Concentration ($\mu g/m^3$)	ACQAA ($\mu g/m^3$)
Trace Elements					
Antimony	4.0	4.1E-04	8.4	1.0	11.9
Arsenic	2.0	1.7E-04	3.6	0.4	4.8
Barium	66.0	5.7E-03	117.9	13.4	11.9
Beryllium	0.4	3.5E-05	0.7	0.1	0.1
Bismuth	0.4	3.5E-05	0.7	0.1	238.1
Boron	67.0	5.8E-03	119.6	13.6	238.1
Bromine	0.4	3.5E-05	0.7	0.1	16.7
Cadmium	0.4	4.1E-05	0.8	0.1	1.2
Cesium	0.3	2.6E-05	0.5	0.1	47.6
Chromium[d]	20.0				
metal/III	19.8	1.7E-03	35.4	4.0	11.9
hexavalent (VI)	0.2	1.7E-05	0.4	0.0	1.2
Cobalt	2.0	1.7E-04	3.6	0.4	1.2
Copper	7.0	6.1E-04	12.5	1.4	4.8
Fluoride	48.0	4.2E-03	85.7	9.7	47.6
Germanium	0.2	1.7E-05	0.4	0.0	14.3
Iodine	0.2	1.7E-05	0.4	0.0	23.8
Lead	2.6	2.7E-04	5.6	0.6	3.6
Manganese	63.5	6.5E-03	133.1	15.1	23.8
Mercury	0.2	2.3E-05	0.5	0.1	0.2
Molybdenum	2.0	1.7E-04	3.6	0.4	119.1
Nickel	9.0	7.8E-04	16.1	1.8	2.4
Selenium	2.0	1.7E-04	3.6	0.4	4.8
Sodium	550.0	4.8E-02	982.2	111.4	119.1
Tellerium	0.7	6.1E-05	1.2	0.1	2.4
Tin	8.0	8.2E-04	16.8	1.9	2.4
Titanium	630.0	5.5E-02	1125.0	127.6	238.1
Uranium	2.0	1.7E-04	3.6	0.4	4.8

Table 4-13. EMISSION FACTORS, UNCONTROLLED EMISSIONS FOR 8 UNITS, MAXIMUM 8-HOUR MODELED CONCENTRATIONS, AND ACQAAs FOR TOXIC OR HAZARDOUS AIR CONTAMINANTS FROM TSPP (concluded)

Toxic or Hazardous Air Contaminant	Average[a] Concentration in Coal (ppm)	Emission[b] Factor for Uncontrolled Emissions (lb/MMBtu)	Uncontrolled[c] Emissions (lb/hr)	Maximum 8-Hour Concentration ($\mu g/m^3$)	ACQAA ($\mu g/m^3$)
Trace Elements (continued)					
Vanadium	7.0	6.1E-04	12.5	1.4	1.2
Yttrium	3.0	2.6E-04	5.4	0.6	23.8
Zinc	9.0	7.8E-04	16.1	1.8	119.1
Zirconium	14.0	1.2E-03	25.0	2.8	119.1
Organics					
Formaldehyde	--	4.5E-04[e]	9.2	1.0	35.7
B(a)P	--	3.9E-06	0.08	2.5E-04[f]	
Cooling Towers					
Chloroform	--	g	1.3	0.9	1,190.5

[a] Based on trace element analyses of coal from Kemmerer and Skyline mines.

[b] Based on average concentration and heating values of 9,800 and 11,500 Btu/lb for Kemmerer and Skyline coals, respectively.

[c] Based on fuel heat input required for maximum guaranteed turbine conditions at full load 2567 MMBtu/hr.

[d] Based on EPA's assessment, 99 percent of chromium from fossil-fuel combustion is in the trivalent form (Federal Register, Vol. 52, No. 87, p. 170005, May 6, 1987).

[e] Emission factor from Radian 1989.

[f] Maximum annual average concentration.

[g] Two percent of added chlorine (EPRI 1986).

for uncontrolled emissions, along with calculated emission rates from the proposed TSPP at full buildout (i.e., eight 250-MW generating units).

Based on a review of literature, formaldehyde and polycyclic organic matter (POM) were the organic pollutants identified as potential contaminants in the second category of THAC (Lokey and Manning 1988; Shih et al. 1980; Radian 1989). The emission factor for formaldehyde is based on recently published emission factors for coal combustion (Radian 1989). Formaldehyde emissions were computed in the same manner as trace elements. As for POM, several compounds are either confirmed or suspected carcinogens; therefore, one of these compounds, benzo(a)pyrene [B(a)P], was selected as the surrogate POM for the purposes of this analysis. This is a health-conservative assumption since B(a)P is one of the more toxic POMs. A TLV value is not available for B(a)P; thus, estimated cancer risks from exposure to B(a)P were assessed at the request of the Air Quality Officer of the NDEP (other carcinogens listed in Table 4-12 were not analyzed in this manner since they had associated TLVs).

Finally, for the third category of potential THACs, radionuclides, emissions from coal combustion are small and the resulting cancer risks are quite low compared to natural background dosages (Lokey and Manning 1988). Radionuclide emissions, therefore, were not considered.

In addition to the power plant stack emissions, potential emissions of chloroform from the cooling towers were evaluated. As discussed earlier, up to 2 percent of the added chlorine in a cooling tower may be converted to trihalomethane compounds, and chloroform would constitute approximately half of these trihalomethanes. As a health conservative assumption, it was assumed that all these potential trihalomethanes would be converted to chloroform and emitted to the atmosphere. The resulting estimated emissions are given in Table 4-13.

To evaluate whether emissions of THACs from the proposed TSPP project would exceed the ACQAAs, air quality dispersion modeling was performed. The same modeling methodologies, described in Section 4.5.1, for the prediction of maximum ambient air concentration increases of criteria pollutants were used in modeling emissions of THACs. Annual and maximum 8-hour average ground-level concentrations were calculated assuming uncontrolled emissions (as required by the NDEP) from the plant (eight units operating). Table 4-13 contains the maximum modeled 8-hour average concentration in ambient air for trace element contaminants, formaldehyde, and chloroform, along with their ACQAAs. Barium, beryllium, and vanadium were the only THACs that exceeded their ACQAAs.

Section 445.719 of the NAC require BACT for those THACs that, without controls, emit more than 0.25 lbs of contaminant per eight-hour shift and exceed applicable ACQAAs. Thus for barium, beryllium, and vanadium, BACT is required. The currently proposed TSPP air pollution control system for SO_2 and PM is a lime spray dryer scrubber and baghouse system. This control technology combination has been conservatively estimated to control beryllium emissions by 99 percent (EPA 1989b) and should be able to control barium and vanadium emissions by the same degree. With this level of control, proposed as BACT for barium, beryllium, and vanadium, the modeled concentrations of these elements are far below their ACQAAs.

As discussed above, B(a)P does not have a TLV that can be used to compute an ACQAA. For B(a)P, the EPA has derived an estimate of its strength as a cancer-causing agent. This constant, the unit risk factor, describes the relationship between inhalation exposure and cancer risk. The cancer risk from exposure to B(a)P is calculated as the product of the unit risk factor (1.7×10^{-3} [$\mu g/m^3]^{-1}$) and the modeled annual average ground-level concentration. For the proposed TSPP, the resultant estimated cancer risk from B(a)P was computed to be 4.3×10^{-7}, that is, a 4.3 chance in 10 million. This cancer risk is well below the commonly used value of 1.0×10^{-6} (one in a million) as an indicator of significant risk (California Air Pollution Control Officers Association [CAPCOA] 1987).

4.4 CONTROL TECHNOLOGIES

4.4.1 Best Available Control Technology Analysis

The PSD regulations require the proposed TSPP to implement BACT. An evaluation of alternative control technologies was performed in a "Top-Down" fashion, as stipulated in recent EPA guidelines concerning BACT (EPA 1989). The "Top-Down" approach requires that the most stringent control technology available for a similar source or source category be identified for each pollutant. Then, for each pollutant, this control technology is evaluated for its technical, energy, environmental, and economic feasibility with respect to the proposed project. If the proposed technology is concluded to result in unreasonable energy, environmental, or economic impacts on the proposed project, the next most stringent level of control is evaluated. This process continues until the control level under consideration cannot be eliminated on any substantial technical, environmental, or economic basis. As stated in Section 4.3.3.1, the alternative control technology analysis presented here is not intended to be a complete BACT analysis. Such an analysis will be submitted with the proposed project's PSD permit application to the NDEP, and the authority to establish final BACT emission limitations will be with the NDEP.

4.4.2 Proposed Emission Limits

The following emission limitations are proposed as BACT for the pulverized coal-fired boilers at the TSPP:

- SO_2 -- 0.18 lbs/MMBtu
- NO_x -- 0.45 lbs/MMBtu
- PM -- 0.015 lbs/MMBtu
- CO -- 0.12 lbs/MMBtu
- Lead -- 96 percent control
- Beryllium -- 96.7 percent control
- Mercury -- 70 percent control

- Fluorides -- 90 percent control
- Sulfuric acid mist -- 86 percent control

The proposed air cleaning technology for NO_x is the use of "Low-NO_x" burners with combustion modifications, for CO, it is proper burner and combustion chamber design, and for SO_2 and all other pollutants, it is a lime spray-dryer/baghouse system.

For permitted utility boilers with the following source characteristics, Tables 4-14 through 4-17 provide previous BACT and lowest achievable emission rate (LAER)[1] determinations:

- Pulverized coal-fired power plant
- Western coal fuel
- Capacity of 200 MW (2400 MMBtu/hr) or more
- Permit issued after January 1, 1980

These previous BACT/LAER determinations were a component of the alternative control technology analysis for the proposed TSPP project. The proposed air cleaning technology for the TSPP is described briefly below, along with the control systems that were rejected in the analysis.

4.4.3 Control of Nitrogen Oxides

4.4.3.1 Proposed BACT. Low-NO_x burners with combustion modifications and a controlled NO_x emission level of 0.45 lb/MMBtu have been proposed as BACT. The maximum estimated emission rate of NO_x is 1155 lb/hr per 250-MW unit, and control efficiency is estimated at 55 percent.

The emissions of NO_x from coal combustion can result from the oxidation of atmospheric nitrogen ("thermal NO_x") or the oxidation of nitrogen compounds in the coal ("fuel-bound NO_x"). Emissions of thermal NO_x are primarily a function of the combustion temperature and the level of excess air at the point of highest temperature, while fuel-bound NO_x emissions are a function of the nitrogen content of the fuel and the level of excess air in the initial (primary) combustion zone. The "Low-NO_x" burners proposed for the TSPP project consist of two concentric annuli through which secondary air flows around the outer coal nozzle sleeve. This "staged-air" nozzle design reduces both thermal and fuel-bound NO_x by creating two combustion zones. In the first zone, air flow is below stoichiometric requirements and incomplete combustion occurs. In the second zone, the incomplete combustion products from the first zone act as NO_x reducing agents, and in addition, excess air from the secondary air flow acts to complete combustion and reduce peak flame temperatures, which further reduces NO_x formation.

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[1] LAER is an emission standard more stringent than BACT, intended for major sources proposing to locate in areas in "nonattainment" of ambient air quality standards. The proposed TSPP would be located in an "attainment" area; thus, BACT applies to the TSPP project.

Table 4-14. PROPOSED SO_2 BACT LIMITATION FOR TSPP IN COMPARISON WITH ALTERNATIVE TECHNOLOGY AND RECENT BACT/LAER DETERMINATIONS FOR 200-MW OR GREATER PULVERIZED COAL-FIRED POWER PLANTS

Project/ Alt. Tech.	Date of Permit	Capacity	SO_2 Limit	SO_2 Control Technology	Cost/Ton Reduced	Applicable to TSSP	Impacts/Limitations
Proposed TSPP	--	8x250 MW	0.18 lb/MMBTU (84-89% control[a])	Dry FGD[b]	\$1000[d]	Yes	High lime requirement Dry waste product
Alternative Technology	--	--	90% control	FBC[c]	NA[e]	No	Unproven for boilers >100MW. Scale-up difficulties.
Intermountain Power	12/85	2x700 MW	0.15 lb/MMBTU	Wet scrubber	\$1100[d]	No[f]	High water consumption Liquid waste product
White Pine Power	11/82	2x750 MW	0.19 lb/MMBTU	Dry FGD[b]	\$1000[d]	Yes	High lime requirement Dry waste product
Washington Water Power	11/82	2080 MW	0.22 lb/MMBTU	Not stated	--	--	--
Plains Electric Generator	5/81	210 MW	0.20 lb/MMBTU	Dry FGD[b]	\$1000[d]	Yes	High lime requirement Dry waste product
Nevada Power Co. (Harry Allen Station)	4/81	4x560 MW	0.10 lb/MMBTU	Wet scrubber	\$1100[d]	No[f]	High water consumption Liquid waste product
Utah Power & Light (Hunter Station)	6/80	1600 MW	0.12 lb/MMBTU	Wet scrubber	\$1100[d]	No[f]	High water consumption Liquid waste product
Intermountain Power	6/80	3000 MW	0.15 lb/MMBTU	Wet scrubber	\$1100[d]	No[f]	High water consumption Liquid waste product
Platte River Power (Rawhide Project)	5/80	250 MW	0.13 lb/MMBTU	Dry FGD[b]	\$1000[d]	Yes	High lime requirement Dry waste product
Tucson Electric Power (Unit #3)	4/80	350 MW	0.22 lb/MMBTU	Dry FGD[b]	\$1000[d]	Yes	High lime requirement Dry waste product
Desert Generator & Trans. (Moon Lake)	2/80	800 MW	0.055 lb/MMBTU	Wet scrubber	\$1100[d]	No[f]	High water consumption Liquid waste product

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[a] Depends on type of coal.

[b] Dry flue gas desulfurization.

[c] Fluid bed combustion.

[d] Approximate.

[e] Insufficient costing data; dependent on combustor design.

[f] Insufficient water at TSPP site.

Sources: EPA 1985b, 1986c, 1987, 1988f

Table 4-15. PROPOSED NO_x BACT LIMITATION FOR TSPP IN COMPARISON WITH ALTERNATIVE TECHNOLOGY AND RECENT BACT/LAER DETERMINATIONS FOR 200-MW OR GREATER PULVERIZED COAL-FIRED POWER PLANTS

Project/ Alt. Tech.	Date of Permit	Capacity	NO_x Limit	NO_x Control Technology	Cost/Ton Reduced	Applicable to TSSP	Impacts/Limitations
Proposed TSPP	--	8x250 MW	0.45 lb/MMBTU (55% control)	Low NOx, combustion modific.	<$100	Yes	No adverse impacts
Alternative Technology	--	--	80% control	SCR[a]	NA[d]	No	Unproven on U.S. coal-fired boiler.
Alternative Technology	--	--	70% control	NCRA[b]	$1200[e]	No	No operating experience on utility-sized coal-fired boiler. Significant potential for ammonia slip.
Alternative Technology	--	--	50-80% control	NCRU[c]	$1350[e]	No	No operating experience on utility-sized coal-fired boiler.
Intermountain Power	12/85	2x700 MW	0.55/MMBTU	Low NOx, combustion modific.	<$100	Yes	No adverse impacts
White Pine Power	11/82	2x750 MW	0.55/MMBTU	Combustion control	<$100	Yes	No adverse impacts
Washington Water Power	11/82	2080 MW	0.5 lb/MMBTU	Not stated	--	--	No adverse impacts
Plains Electric Generator	5/81	210 MW	0.45 lb/MMBTU	Combustion control	<$100	Yes	No adverse impacts
Nevada Power Co. (Harry Allen Station)	4/81	4x560 MW	0.44 lb/MMBTU	Low NOx, combustion modific.	<$100	Yes	No adverse impacts
Utah Power & Light (Hunter Station)	6/80	1600 MW	0.55 lb/MMBTU	Boiler design	<$100	Yes	No adverse impacts
Intermountain Power	6/80	3000 MW	0.55 lb/MMBTU	Boiler design	<$100	Yes	No adverse impacts
Platte River Power (Rawhide Project)	5/80	250 MW	0.5 lb/MMBTU	Boiler design	<$100	Yes	No adverse impacts
Tucson Electric Power (Unit #3)	4/80	350 MW	0.44 lb/MMBTU	Combustion modific.	<$100	Yes	No adverse impacts

Table 4-15. PROPOSED NO_x BACT LIMITATION FOR TSPP IN COMPARISON WITH ALTERNATIVE TECHNOLOGY AND RECENT BACT/LAER DETERMINATIONS FOR 200-MW OR GREATER PULVERIZED COAL-FIRED POWER PLANTS (concluded)

Project/ Alt. Tech.	Date of Permit	Capacity	NO_x Limit	NO_x Control Technology	Cost/Ton Reduced	Applicable to TSSP	Impacts/Limitations
Desert Generator & Trans. (Moon Lake)	2/80	800 MW	0.55 lb/MMBTU	Boiler design	<$100	Yes	No adverse impacts

[a] SCR = Selective Catalytic Reduction
[b] NCRA = Noncatalytic Reduction with Ammonia
[c] NCRU = Noncatalytic Reduction with Urea
[d] No U.S. data available.
[e] Approximate.

Sources: EPA 1985b, 1986c, 1987, 1988f

Table 4-16. PROPOSED PM BACT LIMITATION FOR PROPOSED TSPP IN COMPARISON WITH RECENT BACT/LAER DETERMINATIONS FOR 200-MW OR GREATER PULVERIZED COAL-FIRED POWER PLANTS

Project/ Alt. Tech.	Date of Permit	Capacity	PM Limit	PM Control Technology	Cost/Ton Reduced	Applicable to TSSP	Impacts/Limitations
Proposed TSPP	--	8x250 MW	0.015 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts
Intermountain Power	12/85	2x700 MW	0.02 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts
White Pine Power	11/82	2x750 MW	0.02 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts
Washington Water Power	11/82	2080 MW	0.03 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts
Plains Electric Generator	5/81	210 MW	0.03 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts
Nevada Power Co. (Harry Allen Station)	4/81	4x560 MW	0.015 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts
Utah Power & Light (Hunter Station)	6/80	1600 MW	0.03 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts
Intermountain Power	6/80	3000 MW	0.02 lb/MMBTU	Electrostatic Precipitator	NA	No	Baghouse is strongly preferred with dry FGD
Platte River Power (Rawhide Project	5/80	250 MW	0.026 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts
Tucson Electric Power (Unit #3)	4/80	350 MW	0.026 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts
Desert Generator & Trans. (Moon Lake)	2/80	800 MW	0.03 lb/MMBTU	Baghouse	NA	Yes	No adverse impacts

Sources: EPA 1985b, 1986c, 1987, 1988f

Table 4-17. PROPOSED CO BACT LIMITATION FOR TSPP IN COMPARISON WITH ALTERNATIVE TECHNOLOGY AND RECENT BACT/LAER DETERMINATIONS FOR 200-MW OR GREATER PULVERIZED COAL-FIRED POWER PLANTS

Project/ Alt. Tech.	Date of Permit	Capacity	CO Limit	CO Control Technology	Cost/Ton Reduced	Applicable to TSSP	Impacts/Limitations
Proposed TSPP TSPP	--	8x250 MW	0.12 lb/MMBTU (100 ppm)	Proper design	Low	Yes	Lower CO limit at expense of higher NO_x emissions.
Alternative Technology	--	--	10 ppm	Catalyst	High	No	Catalyst subject to poisoning by coal combustion byproducts. Unproven on coal-fired utility boiler.
Intermountain Power	12/85	700 MW	NA[a]	NA[a]	NA	NA	NA
White Pine Power	11/82	2x750 MW	0.05 lb/MMBTU	Not stated	NA	NA	NA
Washington Water Power	11/82	2080 MW	0.16 lb/MMBTU	Not stated	NA	NA	NA
Plains Electric Generator	5/81	210 MW	0.063 lb/MMBTU	Combustion control	Low	Yes	Not Known
Nevada Power Co. (Harry Allen Station)	4/81	4x560 MW	0.04 lb/MMBTU	Proper design	Low	Yes	Not Known
Utah Power & Light (Hunter Station)	6/80	1600 MW	NA[a]	NA[a]	NA	NA	NA
Intermountain Power	6/80	3000 MW	0.04 lb/MMBTU	Not shown	Low	NA	NA
Platte River Power (Rawhide Project)	5/80	250 MW	NA[a]	NA[a]	NA	NA	NA
Tucson Electric Power (Unit #3)	4/80	350 MW	NA[a]	NA[a]	NA	NA	NA
Desert Generator & Trans. (Moon Lake)	2/80	800 MW	No limit	No control	NA	NA	NA

[a] No BACT determination made.

Sources: EPA 1985b, 1986c, 1987, 1988f

The combustion modifications proposed for the TSPP project consist of burners out of service and low excess air. Burners out of service is the stoppage of fuel flow to some of the upper burners, so that only air passes through. Low excess air is an operational strategy in which a continuous emission monitoring system in the flue gas is used to control the flow of fuel and air to the burners to maintain the lowest possible excess air. Both burners out of service and low excess air reduce fuel-bound NO_x formation by reducing the oxygen level in the primary combustion zone. The combination of Low-NO_x burners with combustion modifications is a proven technology for pulverized coal utility boilers.

4.4.3.2 Alternative Control Systems. The following control technologies for NO_x, listed in decreasing order of potential control efficiency, were considered but rejected:

Selective Catalytic Reduction with Ammonia. Ammonia is injected into the flue gas, upstream of a catalyst, at a point where the temperature is in the range of 650-750°F. The ammonia reacts with NO_x to form nitrogen. This technology is capable of achieving NO_x reductions of 80 percent or better; however, to date, there has been no commercial installation on a coal-fired boiler in the U.S. Currently, as part of a 45-month demonstration project funded by the Department of Energy (DOE), the Ohio Edison Niles power plant is installing a 35-MW SCR retrofit on an existing 100-MW coal-fired plant (Chowdhury 1989). This technology is expected to reduce NO_x emissions by 90 percent or more. Since results from this technology will not be available for several years, it remains unproven for this application.

Noncatalytic Reduction with Ammonia. Ammonia is injected into the flue gas at a point where the temperature is in the range of 1700-1800°F. The ammonia reacts with NO_x to form nitrogen. This technology can achieve NO_x reductions of about 70 percent. It has been installed on coal-fired fluid bed boilers up to 50-MW capacity, but has not been installed on a utility-sized coal-fired boiler using low-sulfur western coal and commercially proven and, therefore, has been rejected.

Noncatalytic Reduction with Urea. The process is identical to noncatalytic reduction with ammonia, except that the reagent is an aqueous solution of urea, which is sprayed into the flue gas. This technology can achieve NO_x reductions of 50 to 80 percent. It has not been demonstrated in continuous commercial operation on a utility-sized coal-fired boiler and is, therefore, considered unproven in this application.

Low-NO_x Burners. A low-NO_x burner consists of two concentric annuli through which the secondary air flows around the outer coal nozzle sleeve. Turbulence is minimized in the inner annular region nearest to the fuel, while the major portion of the air is directed to the outer annular region. In this manner oxygen availability to the fuel, in the region near the burner throat, is limited. This control technology has a control efficiency of about 50 percent, which is less than the Low-NO_x burners with combustion modification, and consequently has been rejected.

Flue Gas Recirculation. Combustion air is mixed with up to 18 percent of the flue gas, which acts as an inert dilutant and lowers the flame temperature. The lower temperature limits the oxidation of atmospheric nitrogen, and will yield a control efficiency of about 50 percent, which is less than either of the Low-NO_x burner options. Consequently, this alternative has been rejected.

Fluid Bed Combustion. Fluid bed combustion will yield a control efficiency of about 50 percent but is unproven at the boiler size of this project (250 MW per module). The largest fluid bed units with significant operating experience have capacities of approximately 100 MW, and difficulties have been experienced in scaling up the technology. Therefore, this control technology has been rejected.

4.4.4 Control of Sulfur Dioxide

4.4.4.1 Proposed BACT. A lime spray dryer/baghouse system (dry flue gas desulfurization [FGD]), with a controlled emission level of 0.18 lb SO_2/MMBtu, has been proposed as BACT. The maximum estimated emission rate of SO_2 per 250-MW unit is 462 lb/hr, and control efficiency is estimated to be between 84 and 91 percent, depending on the type of coal being burned. With the performance coal, the control efficiency is estimated to be 87 percent.

The proposed dry FGD system consists of three spray dryer vessels with a baghouse (fabric filter system) downstream. Flue gas exiting the boiler system would enter the top of the spray dryers at approximately 280 F, where the gas would be evenly distributed at velocities and directions designed for optimal contact with a finely atomized spray of slaked lime (calcium hydroxide) and recycle ash (ash recycled from the downstream baghouse). As the gas passes through the cloud of atomized lime slurry, the SO_2 in the flue gas would react with calcium hydroxide in the slurry to form calcium salts. Simultaneously, the sensible heat in the gas would cause water in the slurry mist to evaporate, leaving a dry particulate residue consisting of the calcium salts, fly ash, and excess lime suspended in the gas stream. The gas would also be cooled by this evaporative process to approximately 165 F at the exit of the spray dryer chambers. The scrubber reaction products and fly ash would be removed from the gas stream by the downstream baghouse. Further details regarding this control system can be found in Section 1.1.3.2.

4.4.4.2 Alternative Control Systems. The following control technologies for SO_2, listed in decreasing order of potential control efficiency, were considered but rejected.

Wet Scrubber with Limestone Forced Oxidation. In this process, a slurry of limestone is sprayed into the flue gas and reacts to form solid calcium sulfate (gypsum), which is dewatered and sent to a solid waste management unit. Wet scrubbers were rejected from consideration due to their high water consumption and the limitations of water at the project site.

Fluid Bed Combustion with Limestone Injection. This technology can yield a control efficiency of up to 90 percent, but, as stated above, is unproven at the boiler size of this project (250 MW per module) and, therefore, was rejected. Currently, the DOE is funding a 72-month demonstration project for a 256-MW circulating fluidized-bed coal-fired boiler owned by the Southwestern Public Service Company (Chowdhury 1989). This technology is expected to yield 70 percent capture of SO_2 from the burning of subbituminous coal.

Limestone Injection into Furnace. Fine crushed limestone is injected into the furnace, typically through the coal burners, where it reacts to form solid calcium sulfite/sulfate, which is removed in the flue gas particulate removal system (baghouse or electrostatic precipitator [ESP]). Control efficiencies are low (approximately 50 percent), which is less than selected control technology using a lime spray dryer. Therefore, this control method was rejected.

Dry Lime Injection into Duct. Dry hydrated lime is injected into the flue gas duct, where it reacts to form solid calcium sulfite/sulfate, which is removed in the flue gas particulate removal system (baghouse or ESP). Control efficiencies are low (approximately 40 percent), much lower than a lime spray dryer, and there are no commercial applications in the U.S. Therefore, this control method was rejected.

4.4.5 Control of Particulate Matter

4.4.5.1. Proposed BACT. A baghouse (fabric filter system) with reverse flow cleaning and a controlled emission level of 0.015 lb PM_{10}/MMBtu has been proposed as BACT. The maximum expected emission rate is 39 lb/hr per 250-MW unit, and control efficiency is estimated at 99.8 percent.

A baghouse system consists of cylindrical bags of fabric filter connected to a common inlet manifold. The inlet manifold would distribute the particulate-laden gas stream throughout the baghouse compartments, and deposit PM on the interior of the filter bags. Cleaned gas, exiting the filter bags of each compartment, would be drawn into an outlet manifold. PM collected on the interior of the bags would be periodically dislodged by a reverse gas cleaning process. Further details regarding this control system can be found in Section 1.1.3.2.

4.4.5.2 Alternative Control Systems One other control technology was considered for PM_{10}, which is capable of achieving a similar level of emission control:

Electrostatic Precipitator. The flue gas passes between electrodes maintained at a high potential, which attract and neutralize charged PM in the gas. The technology is proven, but is very sensitive to the composition of the solids, and may be adversely influenced by the reagents used for SO_2 control. A control efficiency of 99.8 percent should be achievable. This control technology was rejected because a baghouse system is strongly preferred over an ESP for use with the lime spray dryer for SO_2 control.

4.4.6 Control of Carbon Monoxide

4.4.6.1 Proposed BACT. The formation of CO from the combustion of fossil fuels is the result of incomplete or non-stoichiometric combustion. Therefore, proper burner and combustion chamber design, with a CO emission level of 0.12 lb/MMBtu (or 100 parts per million [ppm] on a dry gas basis), has been proposed as BACT. The maximum estimated emission rate of CO is 298 lb/hr per 250-MW unit.

Lower CO emissions are technically and economically feasible if the project does not use the Low-NO_x burners and combustion modifications proposed for NO_x control. Low-NO_x burners form more CO in the primary combustion zone than conventional burners. Although the CO is oxidized to CO_2 when the combustion products contact the secondary and overfire air, stack-gas CO levels will be at 100 ppm versus 50 ppm for a well-trimmed conventional burner. Taking into consideration overall ambient air quality impacts, including photochemical oxidants, higher NO_x control was chosen over slightly lower CO emissions. In addition, the projected maximum CO impacts from the proposed project are insignificant.

4.4.6.2 Alternative Control Systems. The following control technologies for CO, listed in decreasing order of potential control efficiency, were considered but rejected:

Catalysts. Catalysts have been used on natural gas turbine installations in California to reduce CO emissions to very low levels, typically below 10 ppm. However, they require a temperature of 1000 F and an oxygen level of 15 percent, both of which are much higher than what would be present in the flue gas of the proposed project. A large quantity of additional fuel would be required to achieve the desired catalyst temperature, which would pose an unacceptable economic burden on the project, and would further add to emissions of pollutants other than CO. In addition, catalysts are extremely expensive to install, and susceptible to poisoning by PM in the gas stream. Therefore, this alternative has been rejected.

Afterburners. High concentrations of CO are generated in the decarbonization of molten steel. The high CO content of these exhaust gases presents an explosion hazard; thus, air is typically added to the gases in an afterburner. The gases are held at a temperature of at least 1400°F to oxidize the CO to CO_2. However, both the temperature and the CO content of the proposed TSPP's flue gas will be much lower than those in the steel industry. In addition, as with a CO catalyst, a large quantity of fuel would be required to achieve the desired afterburner temperature, which would pose an unacceptable economic burden on the project, and would further add to emissions of pollutants other than CO. This control method, therefore, has been rejected.

4.4.7 Control of Lead and Noncriteria Pollutants

4.4.7.1 Proposed BACT. BACT is required for lead, beryllium, mercury, fluorides, and sulfuric acid mist. Lead and beryllium compounds are emitted almost entirely as PM, thus the control technology proposed as BACT for PM (baghouse) is proposed as BACT for lead and beryllium. Emissions of fluorides and sulfuric acid mist can be controlled by the proposed SO_2 control technology (spray dryer/baghouse); thus, this control system is proposed as BACT for fluorides and sulfuric acid mist. Emissions limitations for these compounds are presented in Section 4.4.2.

4.4.7.2 Alternative Control Systems. There were no other identified emission control systems for lead and noncriteria pollutants with higher control efficiencies than those proposed above as BACT.

4.5 AIR QUALITY PROJECTIONS

4.5.1 Modeling Methodologies and Air Quality Analyses

This section describes the methods used for preparing meteorological and air quality data for dispersion modeling of emissions from the proposed TSPP and the methods used in the dispersion modeling.

4.5.1.1 Meteorological Data. Meteorological data collected on site were prepared for air quality modeling using the RAMMET meteorological preprocessor program developed by the EPA. RAMMET produces a binary file of hourly stability, windspeed, wind direction, ambient temperature, and mixing height which can be used to input to EPA's air quality models.

On-site meteorological data were used for all meteorological parameters except mixing height. Windspeed, wind direction, and standard deviation of the horizontal wind direction (σ_θ) were measured at both 10 and 100 meters. The windspeed and σ_θ at 10 meters were used to calculate Pasquill-Gifford stability class. Temperature was measured at 10 meters. The data set used in modeling consisted of windspeed and wind direction at 100 meters, stability based on 10-meter wind data, and temperature at 10 meters.

On-site meteorological data collected from June 15, 1981 through June 14, 1982 were used for modeling. The percentages of valid meteorological data for windspeed, wind direction, temperature, and σ_θ for the period from June 15, 1981 through June 14, 1982 for both the 10- and 100-meter levels prior to data substitution were as follows:

- 10 meters

Windspeed	99
Wind direction	99
Temperature	98
Sigma theta	92

- 100 meters

Windspeed	94
Wind direction	99
Sigma theta	95

Morning and afternoon mixing heights for Ely, Nevada, prepared by the National Climatic Data Center (NCDC) for the same time period as the on-site meteorological data were used.

Since some data gaps existed in the 1-year data set ranging from 1 hour to 24 hours, data substitution methods were used to obtain a more complete data set for modeling purposes. These methods are described below:

If 5 consecutive hours of data, or less, were missing, the following procedures were used:

- For the case of 5 hours of missing data, missing hours 1 and 2 were set equivalent to the prior hour, missing hours 4 and 5 were set to the succeeding hour, and missing hour 3 was set equivalent to the arithmetic average of the preceding and succeeding nonmissing hours.
- If 5 hours of data were missing, missing hours 1 and 2 were set equivalent to the prior hour, and missing hours 3 and 4 were set to the succeeding hour.
- If 3 hours of data were missing, hour 1 was set equivalent to the prior hour, missing hour 3 was set equivalent to the succeeding hour, and missing hour 2 was set equivalent to the arithmetic average of the preceding and succeeding nonmissing hours.
- If 2 hours of data are missing, missing hour 1 was set equivalent to the prior hour, and missing hour 2 was set equivalent to the succeeding hour.
- If 1 hour of data was missing, then the missing hour was set equivalent to the arithmetic of average of the preceding and succeeding nonmissing hours.

For data gaps larger than 5 hours, if other meteorological data from different tower levels were available for substitution, these data were used. The following procedures were used for data substitution:

- If the windspeed at 100 meters was missing, then the windspeed at 10 meters, if available, adjusted using the default rural power law exponents from the Industrial Source Complex (ISC) model, were used.

- If the wind direction at 100 meters was missing, then the wind direction from the 10-meter level, if available, was used.
- If σ_θ at 10 meters (used to compute stability class) was missing, then the stability class at 100 meters computed using σ_θ at 100 meters and the windspeed at 10 meters were used.

In addition, if temperature data were missing, then Elko, NV temperature was used, after adjusting the temperature hydrostatically for elevation differences (i.e., temperature decreased 5.5°F per 1000 feet of elevation increase).

If data were still missing after the above data interpolations and substitutions had been performed (e.g., due to missing data at both levels), then the data were coded as "calm" so the computer models would not compute concentrations for these periods. Using the above procedures, the resulting data set consisted of 8696 hours of meteorological data that were used for modeling purposes.

4.5.1.2 Air Quality Modeling and Analyses. Air dispersion modeling was performed for all eight phases of project development (250 MW per phase). The air quality analyses considered emissions of criteria pollutants SO_2, NO_x, PM, and CO. Emissions of toxic air pollutants were also included in the analyses.

The dispersion modeling analyses used the EPA-approved models Industrial Source Complex Short Term (ISCST), COMPLEX I, and the Rough Terrain Dispersion Model (RTDM). All these models are Gaussian models and are the most widely used techniques for estimating impacts of nonreactive pollutants. These steady-state models are appropriate for calculating short-term (1-, 3-, 8-, and 24-hour) average concentrations and the long-term (annual) average concentrations in a rural environment. In addition to the above air quality models, the EPA calm processing program, CALMPRO, was used in conjunction with the RTDM model since RTDM does not have calm processing capabilities, as do ISCST and COMPLEX I.

For modeling purposes, all emissions from the power plant stacks were assumed to exhaust from one centrally located stack, using the stack parameters shown in Table 4-18.

Short-term and long-term concentration calculations were required to address NAAQS, PSD increments, and ARQVs.

The modeling analysis employed the "Third Level Screening Technique (Rural)" for complex terrain as described in EPA (1986b). That is, the ISCST model was used to calculate concentrations at locations with elevations below the stack top (i.e., simple terrain) while the COMPLEX I and RTDM models were used to calculate concentrations at receptors with elevations above the top of the stack. In modeling the proposed TSPP emissions, deposition or chemical transformation of the pollutants with the

Table 4-18. SOURCE PARAMETERS FOR THE PROPOSED THOUSAND SPRINGS POWER PLANT

Stack Location UTM Coordinates East (km)	Stack Location UTM Coordinates North (km)	Height (ft)	Elevation (ft)	Temperature (°F)	Diameter (ft)	Exit Velocity (ft/sec)
706.0	4578.9	450	5700	140	18.0	60.0

ISC, COMPLEX I, or RTDM models was not used. Thus, this modeling should yield conservative results since credit is not taken for these depletion or conversion mechanisms.

Modeling was performed in two phases. The first was to use the ISCST and COMPLEX I models to compute ground-level concentrations at receptors on a coarse receptor grid array. From this modeling, the general location(s) of maximum ground-level concentrations were identified. The second phase was to use the RTDM model (since the maximum concentrations occurred in complex terrain) with a more dense array of receptors in the areas of high concentration to compute ground-level concentrations.

Two basic receptor grid types, coarse and dense, were used for the NAAQS and PSD increment air quality modeling. Both grid types were based on a Cartesian coordinate system. The coarse grid used a 1-km spacing. The extent of the coarse grid system was such that the locations of maximum modeled concentration were contained within its boundaries. The coarse grid extended out approximately 50 km (or greater) in each direction from the TSPP site. The dense grid system(s) used a 100-meter grid spacing.

The ISCST and COMPLEX I models were run using a coarse grid. These runs were used to define the impact and significance areas. From the ISCST and COMPLEX I model runs the locations of the highest of the 1st and 2nd high concentrations for each appropriate averaging periods were identified, as well as the maximum annual concentrations.

Additional modeling at the locations of predicted high concentrations was performed using the RTDM model and a series of fine grids. These fine grids consisted of receptors spaced 100 meters apart centered on the locations of predicted high concentrations. The grids extended 500 meters to the north, east, south, and west at each location.

RTDM was also used for air quality modeling of Jarbidge Wilderness Area (a Class I area) and the extension of Jarbidge Wilderness Area. For this modeling, a 1-km grid was used. Receptors were placed within and along the borders of Jarbidge Wilderness Area, extending into the wilderness area up to a northeast-southwest oriented ridgeline (elevation between approximately 8000 and 9000 feet). This ridgeline defines for this analysis the furthest limit of the terrain to be modeled in RTDM. Based on preliminary results using the COMPLEX I model, the plume height in Jarbidge Wilderness Area occurred at elevations between 6000 and 7000 feet. Thus, the receptor grid would include terrain where plume impaction may occur. Figure 4-1 shows Jarbidge Wilderness Area and the wilderness area addition along with the receptor grid used for air quality modeling.

For SO_2, NO_2, and PM, modeled concentration increases due to the proposed TSPP project were added to maximum measured background concentrations (collected on site). For PM, the resulting projected concentrations were compared against the Nevada Ambient Air Quality Standards since the Nevada standards are equal to or more restrictive than

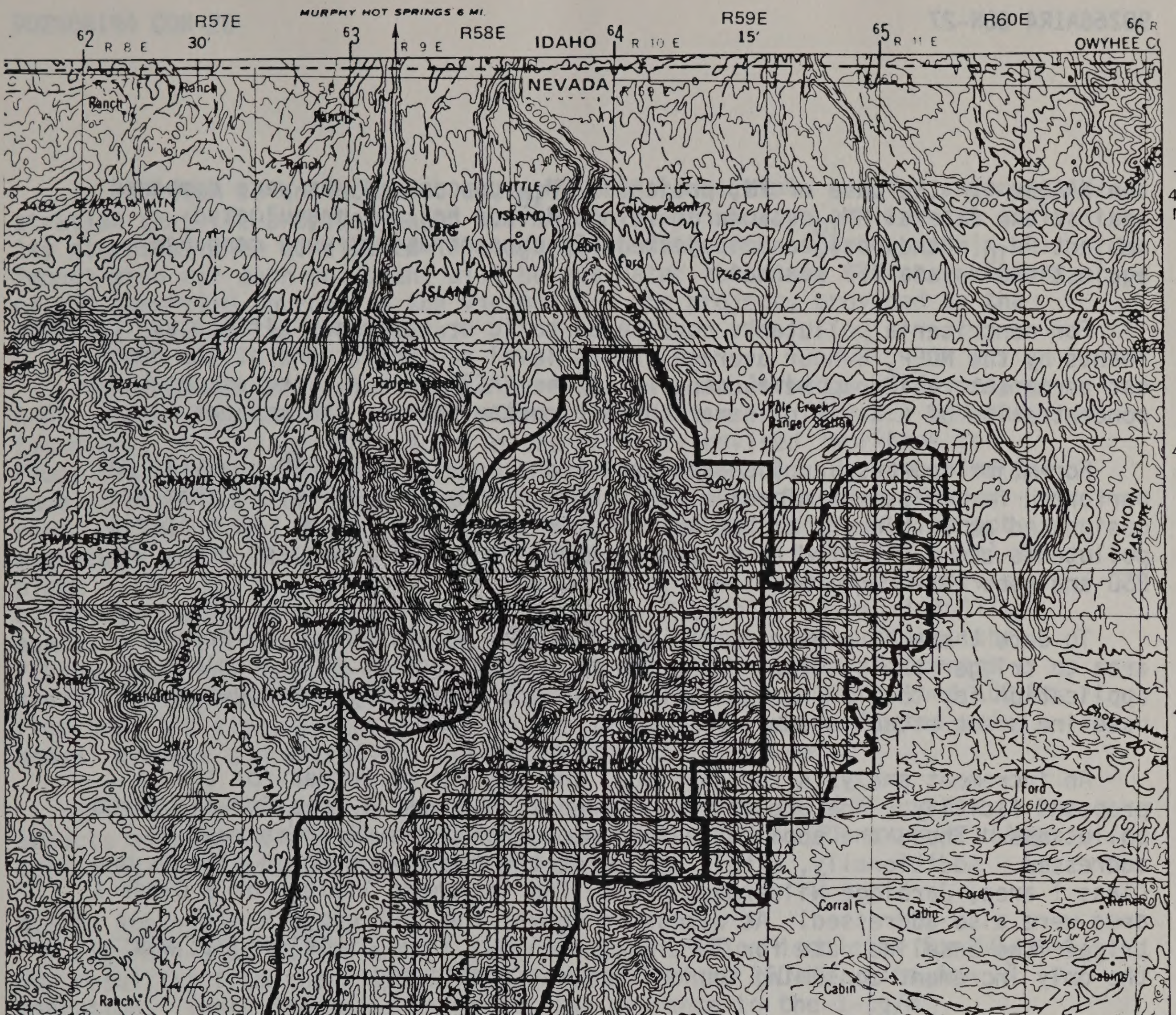


Figure 4-1. RECEPTOR GRID USED FOR RTDM AIR QUALITY MODELING OF THE JARBIDGE WILDERNESS AREA AND PROPOSED WILDERNESS AREA EXTENSION

the NAAQS. In the case of PM, projected PM_{10} concentrations were compared against the federal PM_{10} standards (since Nevada has not promulgated ambient PM_{10} standards), and projected TSP concentrations were compared against the Nevada TSP standards.

For noncriteria pollutants considered toxic or hazardous air contaminants by the NDEP, 8-hour average ground-level concentrations at the nearest permanent residence were compared to the "ACQAA," i.e., the acceptable concentration of a toxic or hazardous air contaminant in the ambient air.

For major sources, applicable regulations require that PSD analysis be performed for emissions of pollutants above EPA de minimis levels that are designated as attainment or unclassified in the project area. No criteria pollutants are designated as a nonattainment in the TSPP project area, so PSD analyses were required.

To date there have been no PSD applications submitted in the proposed area to trigger the baseline date, and that upon receipt of a complete application for the TSPP project, the baseline date will be triggered and baseline areas established.

An increment analysis for TSP, SO_2, and NO_2 was performed for the proposed facility. The project is located in a Class II area for all three pollutants. Thus, the applicable increments for Class II areas must be addressed. Additionally, within 100 km of the proposed project site is one Class I area, Jarbidge Wilderness Area. The increment limits for a Class I area were also addressed. As discussed above, the TSPP project will trigger the baseline date for TSP, SO_2, and NO_2. Thus, this project was the only increment consuming source that was considered.

For maximum modeled 3- and 24-hour average ground-level concentration increases computed using RTDM in Jarbidge Wilderness Area, trajectory analysis methods were used to assess the validity of these modeled concentrations. Because the distance from the proposed project site to the closest boundary of Jarbidge is approximately 75 km, the meteorological conditions during which high concentrations could occur (i.e., persistence of winds towards Jarbidge under stable conditions and light windspeeds) are unlikely to exist for a sufficient time period for the plume to be transported directly to Jarbidge Wilderness Area, although the RTDM model computes a concentration for that period assuming instantaneous transport. This is because there is no temporal dependence built into the model. Therefore, for those periods for which increment exceedances were predicted, hourly trajectories were determined to see whether the plume could actually reach Jarbidge Wilderness Area, with the necessary persistent conditions during the averaging period.

In addition to an increment analysis, PSD regulations require a demonstration that the proposed major source would not violate ambient air quality standards when considered in conjunction with other sources within an impact area for each pollutant will be evaluated. A minor source inventory of all permitted sources in the vicinity of the project, provided by the NDEP was used for this analysis.

The proposed project's impacts on visibility in Jarbidge Wilderness Area were assessed using the EPA plume visibility model (PLUVUE) and the techniques and guidance provided in the recently revised "Workbook for Plume Visual Impact Screening and Analysis" (EPA 1988d). By combining the modeled magnitudes of plume visual impact with the frequencies of occurrence of worst-case dispersion conditions, an analysis of visual impact magnitude and frequency is possible. Such an analysis is called Level-3 plume visibility analysis, the most detailed of the three levels of visibility screening recommended by EPA (1988d). A Level-3 plume visibility analysis was performed for the Jarbidge Class I area. In addition, the PLUVUE model was used to assess visibility impacts on other wilderness areas of concern in the project vicinity. For Class I areas beyond 100 km from the TSPP site, potential visibility degradation was evaluated using annual average concentrations predicted with the ISC model.

Emissions of PM_{10} from the cooling towers were calculated and the impacts assessed along with other low-level and fugitive PM sources using screening-level dispersion modeling procedures.

4.5.2 Ambient Air Impacts

Figure 4-2 shows the annual 1 $\mu g/m^3$ concentration isopleths for SO_2 and NO_2 resulting from the proposed TSPP with all eight 250-MW units in operation. These isopleths represent the distance to the 1-$\mu g/m^3$ significance impact limit, as defined by the EPA. At distances beyond these isopleths the EPA would not consider the TSPP as contributing significantly to the degradation of ambient air quality levels. A 1-$\mu g/m^3$ isopleth is not shown for PM because the maximum annual PM impacts resulting form emission from the TSPP boiler stacks would be less than 1 $\mu g/m^3$. Although the coal-, ash-, and lime-handling operations will exceed 1 $\mu g/m^3$, these impacts would be restricted to the immediate vicinity of the facility and, therefore, are not shown on Figure 4-2.

The proposed project is not expected to cause an exceedance of any ambient air quality standard. In addition to complying with ambient air quality standards the TSPP must also comply with PSD increment limits. The air quality increment analysis performed for the proposed project is summarized below.

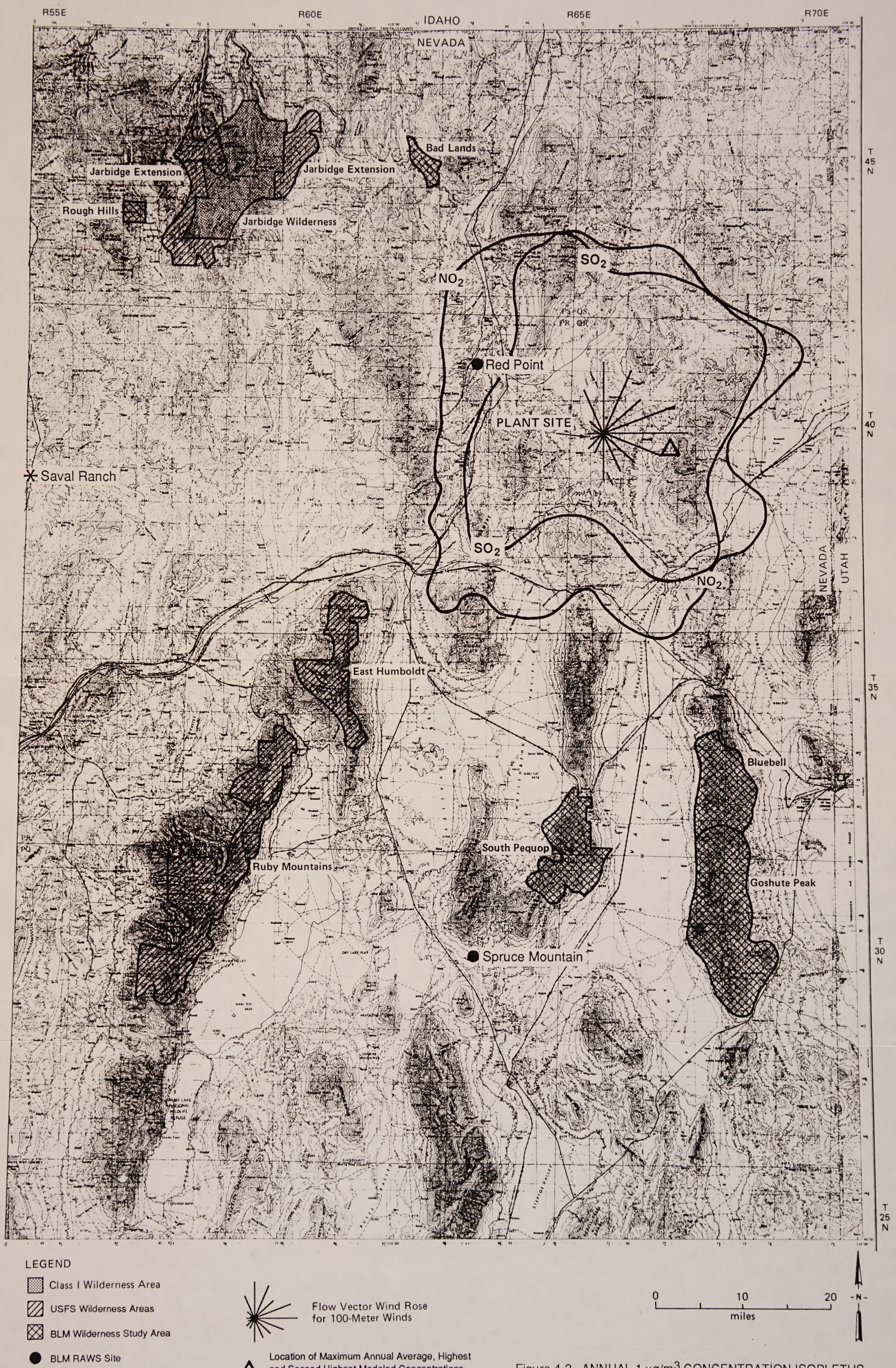
4.5.2.1 Ambient Air Quality Standards Analysis. Air quality impacts from the proposed TSPP were computed using air quality dispersion modeling techniques. Methodologies followed for the impact analysis were those outlined by the EPA PSD guidance documents (EPA 1980, 1986b). Maximum predicted short-term and long-term (annual) impacts were combined with maximum background air quality concentrations identified through the ambient monitoring data. Impacts were evaluated in both the relatively flat terrain immediately surrounding the plant and in the elevated terrain regions in the mountain areas at further distances from the plant. Air emission sources evaluated in the air quality analysis included boiler emissions, cooling tower emissions, and emissions from coal-, ash-, and lime-handling operations.

A screening procedure was used to model emissions from the cooling towers and the coal-, ash-, lime-handling operations based on the ISCST model. This procedure provided a highly conservative estimate of potential air quality impacts from the proposed TSPP. The screening method incorporates the use of 49 potential windspeed and atmospheric stability categories, modeling the maximum downwind impacts for each windspeed/stability combination.

As discussed in Section 4.5.1, emissions from the boiler stacks were modeled using the ISCST, COMPLEX I, and RTDM models. One year of on-site meteorological data was used with these models to compute short- and long-term average concentration increases. Both the COMPLEX I and RTDM models were used for the elevated terrain analysis. The RTDM model incorporates the latest algorithms for modeling the physical movement of the plume over and around a hillside. Modeling of potential impacts in elevated terrain areas further away from the TSPP site incorporated only boiler emissions, since particulate concentrations from fugitive dust sources associated with the coal-, ash-, and lime-handling operations would drop off well before reaching the high terrain areas.

The maximum predicted short- and long-term concentrations from the TSPP boiler stacks, with all eight units in operation, occurred in elevated terrain approximately 7 miles east-southeast of the plant site, at an elevation of about 6500 feet (see Figure 4-2). Maximum short-term concentrations at this location occurred during stable atmospheric conditions with low windspeeds. The maximum particulate concentrations from the coal-, ash-, and lime-handling operations and cooling towers would occur at the fenceline of the facility during neutral atmospheric stability conditions and high windspeeds. Since the particulate emissions from the coal-, ash-, and lime-handling operations would be released at a relatively low height above the ground, maximum predicted concentrations would occur within close proximity to the source before any significant dispersion took place. Particulate emissions from the boilers would be released from 450-foot stacks. Although the amount of PM released through the boiler stacks would be much higher than that generated by the material-handling operations, significant mixing of the stack plume would occur before the plume impinged on any land surface, resulting in lower concentrations than from the coal-, ash-, and lime-handling operations.

It should be noted that at maximum predicted short- and long-term concentration increases from the proposed TSPP project that, as discussed in the Ecological Resources Technical Report and the EIS, both short- or



LEGEND

- ▨ Class I Wilderness Area
- ▨ USFS Wilderness Areas
- ▨ BLM Wilderness Study Area
- ● BLM RAWS Site
- ✳ NADP/NTN Monitoring Station
- ✳ Flow Vector Wind Rose for 100-Meter Winds
- △ Location of Maximum Annual Average, Highest and Second Highest Modeled Concentrations for SO_2, NO_2, and CO

Figure 4-2. ANNUAL 1 $\mu g/m^3$ CONCENTRATION ISOPLETHS FOR SO_2 AND NO_2 FROM TSPP, EIGHT 250 MW UNITS IN OPERATION

long-term changes in regional vegetation composition and productivity are expected.

4.5.2.2 PSD Increment Analysis

Class II Increments. For the increment analysis, the second-highest modeled short-term concentration increase at any receptor (except for the 24-hour average particulate concentration) was identified as well as the maximum annual average concentration. For short-term increments, the EPA PSD regulations [at 40 CFR 52.21(c)] allow one exceedance per year, thus second-highest modeled concentration increases may be used in a short-term increment analysis. These modeled concentrations at full project buildout are shown in Table 4-19 along with the applicable Class II increment. Table 4-20 lists the second-highest modeled concentration increases for the boiler stack emissions only as each 250-MW unit would come into operation.

Table 4-19 shows increment consumption for TSP and NO_2 to be within allowable limits for the proposed TSPP eight 250-MW generating units in operation with current proposed BACT. For SO_2, the analysis shows that emissions from all eight units, each with SO_2 controls at the proposed BACT level of 0.18 lb SO_2/MMBtu, would result in the protection of all applicable increments, except the Class II 24-hour increment. The modeled exceedance of this increment would be a significant air quality impact. However, it should be noted that the TSPP project is proposed to be a "phased construction" project, and the PSD regulations require that the determination of BACT be reviewed prior to the implementation of each independent construction phase. The TSPP project consists of eight individual construction phases that would take place over a period of approximately 20 years. Table 4-20 shows that the current proposed BACT level of 0.18 lb SO_2/MMBtu, when applied to the first seven steam-generating units, results in maximum ground-level concentrations below the Class II 24-hour increment. In order to protect the 24-hour increment when all eight generating units are operational, the seventh and eighth units would need a level of control equivalent to 0.16 lb SO_2/MMBtu, according to the air quality analysis, resulting in a 24-hour-average concentration of 90.4 $\mu g/m^3$ (see footnote in Table 4-19). The applicant has committed to this level of control for the seventh and eight units; therefore, the Class II 24-hour SO_2 increment will be protected. A demonstration of increment protection is a condition of the NDEP's issuance of a PSD permit.

The fact that the proposed TSPP project would be close to the increment limits for SO_2 and NO_2 would not preclude other industrial sources from locating in the area for the following reasons. First, sources that are not major sources (i.e., PSD sources) do not have to comply with increment limits. Therefore, as long as ambient air quality standards would not be violated, other non-PSD sources could locate in the area. They would have to be permitted by the NDEP and would have to demonstrate that their emissions in conjunction with other sources (including TSPP) when added to background concentrations would not exceed the ambient air quality standards. Second, as discussed in Section 2.1.3.2, the available air quality increment depends on how much other sources have reserved at any

Table 4-19. COMPARISON OF INCREMENTS CONSUMED BY TSPP (EIGHT UNITS OPERATING) WITH CLASS II INCREMENTS

Pollutant and Averaging Period	Concentration Increase Due To Project ($\mu g/m^3$)	Class II[a] Increment ($\mu g/m^3$)
Sulfur Dioxide		
3-hour	485.1[b]	512
24-hour	93.0[b,c]	91
Annual	9.9	20
Particulate Matter		
24-hour	26.4	37
Annual	6.5	19
Oxides of Nitrogen		
Annual	24.8	25

[a] Short-term PSD increments (24 hours or less) are not to be exceeded more than once per year, at any location.

[b] Second highest predicted short-term concentration used in analysis because short-term PSD increments allow one exceedance per year.

[c] Predicted 24-hr SO_2 concentration increase of 93.0 $\mu g/m^3$ based on SO_2 emissions of 0.18 lb/MMBtu per unit at full buildout (i.e., 8 units). If SO_2 emissions from the first six units were 0.18 lb/MMBtu and emissions from the last two units were 0.16 lb/MMBtu (or equivalent level of control), then predicted 24-hr SO_2 concentration increase would be 90.4 $\mu g/m^3$.

Table 4-20. COMPARISON OF INCREMENTS CONSUMED AS EACH UNIT COMES INTO OPERATION WITH CLASS II INCREMENT LIMITS (BOILER EMISSIONS ONLY)

Pollutant	X (km)	Receptor Y (km)	Elev. (ft)	Distance from TSPP (km)	Modeled Concentration (µg/m^3) Number of Units 1	2	3	4	5	6	7	8	PSD CLASS II Increment (µg/m^3)
Sulfur Dioxide													
3-hr	718.8	4577.5	6440	12.9	60.6	121.3	181.9	242.6	303.0	363.8	424.5	485.1	512
24-hr	718.8	4577.8	6440	12.9	11.6	23.3	34.9	46.5	58.1	69.8	81.4	93.0	91
Annual	715.8	4574.9	6440	10.6	1.2	2.5	3.7	5.0	6.2	7.5	8.7	9.9	20
Oxides of Nitrogen													
Annual	715.8	4574.9	6440	10.6	3.1	6.2	9.3	12.4	15.5	18.6	21.7	24.8	25
Particulate Matter													
24-hr	718.8	4577.5	6440	12.9	1.0	2.0	2.9	3.9	4.9	5.9	6.9	7.9	37
Annual	715.8	4574.9	6440	10.6	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	19

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[a] Emissions based on 0.18 lb SO_2/MMBtu for all units.

given location. Although the proposed TSPP would, at the location of maximum concentration, consume most of the allowable SO_2 and NO_2 increments at that point, it would not be consuming these increments at all locations in the region. This means that as long as another PSD source, in conjunction with TSPP, would not exceed the increment limits at other locations, it could be located in the same region.

Class I Increments. Because Jarbidge Wilderness Area is a Class I area, a Class I increment analysis was performed. Concentration increases from the proposed TSPP project were computed in Jarbidge Wilderness Area using the EPA-approved RTDM model. For this modeling, a 1-km grid receptor was used. Receptors were placed within and along the borders of the Wilderness Area extending into the Wilderness Area up to a northeast-southwest oriented ridge line (elevation between approximately 8000 and 9000 feet).

The results for the Class I increment analysis are shown in Table 4-21. Based on the RTDM modeling results, the maximum modeled short-term (3- and 24-hour) ground-level concentrations are shown to be above the Class I increment limits. Maximum modeled concentrations predict increment being exceeded for twelve 3-hour periods and seven 24-hour periods. However, for short-term averaging periods the RTDM model may significantly overpredict the impacts in Jarbidge Wilderness Area due to the inherent limitations in the model. Because of this, those periods for which Class I increment exceedances were predicted were evaluated using trajectory analysis methods. In addition to the modeled Class I increment exceedances, four 3-hour periods where the modeled concentration was near the increment limit were also evaluated. Tables 4-22 and 4-23 provide the modeled concentrations in Jarbidge Wilderness Area that were evaluated by trajectory analysis. The locations where the short-term modeled concentrations exceeded the increment are shown on Figure 4-3.

Because the distance from the proposed TSPP site to the closest boundary of Jarbidge is about 75 km, the meteorological conditions during which high concentrations could occur (i.e., persistence of winds towards Jarbidge during stable conditions and light windspeeds) are unlikely to exist for a sufficient time period for the plume to be transported to the wilderness area, although the RTDM model computes a concentration for that period assuming instantaneous transport. This is because there is no temporal dependence built into the model. So, even though the plume may not be able to travel to the wilderness in the given time period (travel time is determined by the windspeed) the model will still compute a concentration as if the plume were there.

For short-term averaging periods the RTDM model calculates a 3- or 24-hour average concentration by averaging the appropriate number of individual 1-hour concentrations. Table 4-24 provides the meteorological conditions for each of the 3-hour time periods evaluated in the trajectory analysis. Tables 4-25 through 4-31 provide the same information but for each of the 24-hour time periods evaluated. The associated trajectories

Table 4-21. MAXIMUM MODELED GROUND-LEVEL CONCENTRATIONS FROM TSPP (EIGHT UNITS IN OPERATION) IN JARBIDGE WILDERNESS AREA COMPARED WITH CLASS I INCREMENTS

Pollutant and Averaging Period	Modeled Concentration Increase Due To Project ($\mu g/m^3$)	Class I[a] Increment ($\mu g/m^3$)
Sulfur Dioxide		
3-hour	55.9[b]	25
24-hour	10.7[b]	5
Annual	0.3	2
Particulate Matter[c]		
24-hour	0.7	10
Annual	0.03	5
Nitrogen Dioxide		
Annual	0.8	2.5

[a] Short-term PSD increments (24 hours or less) are not to be exceeded more than once per year, at any location.

[b] Modeled concentration increases shown exceed the Class I increments. Further evaluation by trajectory analysis shows these modeled concentrations could not occur.

Table 4-22. MAXIMUM MODELED 3-HOUR AVERAGE SO_2 GROUND-LEVEL CONCENTRATIONS IN JARBIDGE WILDERNESS AREA EVALUATED USING TRAJECTORY ANALYSIS

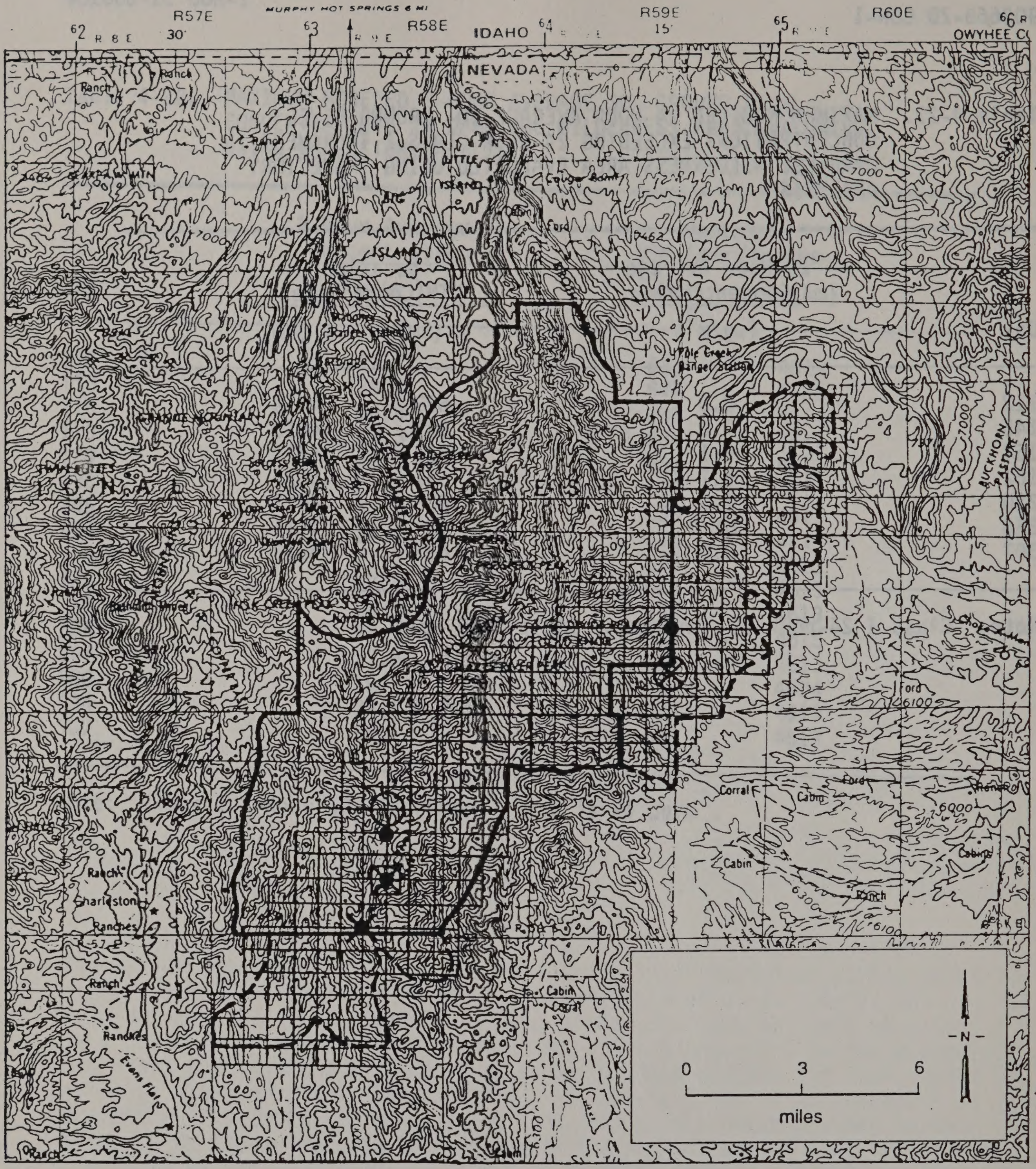
Day	3-Hour Average Concentration ($\mu g/m^3$)	Location UTM Coordinates x (km)	y (km)
112	47.2	633	4613
113	28.6	647	4625
118	24.8	633	4614
120	27.3	634	4617
129	28.0	633	4613
130	24.7	633	4613
145	55.9	633	4613
154	27.8	633	4613
158	27.3	633	4613
186	27.4	634	4615
220	29.3	633	4613
234	27.1	634	4615
241	27.5	633	4613
280	19.3	647	4624
284	24.3	633	4613
307	55.1	633	4613

Note: Class I 3-Hour SO_2 increment limit is 25 $\mu g/m^3$.

Table 4-23. MAXIMUM MODELED 24-HOUR AVERAGE SO_2 GROUND-LEVEL CONCENTRATIONS EXCEEDING 24-HOUR CLASS I INCREMENT IN JARBIDGE WILDERNESS AREA EVALUATED USING TRAJECTORY ANALYSIS

Day	24-Hour Average Concentration ($\mu g/m^3$)	Location UTM Coordinates x (km)	y (km)
112	8.0	633	4613
145	7.0	633	4613
154	5.1	633	4613
162	5.2	647	4624
220	7.9	633	4613
256	10.7	634	4615
307	9.0	633	4613

Note: Class I 24-hour SO_2 increment limit is 5 $\mu g/m^3$.



LEGEND

——— Jarbidge Class I Wilderness Area

- - - - Jarbidge Class II Wilderness Area

● 3-hr average concentration greater than Class I increment

X 24-hr average concentration greater than Class I increment

○ Highest 3-hr average concentration less than Class I increment

□ Highest 24-hr average concentration less than Class I increment

Figure 4-3. LOCATIONS OF RECEPTORS IN JARBIDGE WILDERNESS AREA WHERE 3- AND 24-HOUR CONCENTRATIONS EXCEEDED THE CLASS I INCREMENT AND LOCATIONS OF HIGHEST 3- AND 24-HOUR CONCENTRATIONS NOT EXCEEDING THE CLASS I INCREMENT

Table 4-24. METEOROLOGICAL CONDITIONS FOR 3-HOUR PERIODS ANALYZED IN TRAJECTORY ANALYSIS

Day	Hour	Wind Direction (Deg)	Windspeed (m/sec)	Stability Class
112	1	112	1.4	F
	2	124	0.8	F
	3	135	0.6	E
113	7	139	0.9	F
	8	135	0.7	A
	9	251	0.9	A
118	4	169	2.1	F
	5	111	1.5	E
	6	115	1.8	F
120	19	283	0.7	F
	20	122	0.7	F
	21	37	1.2	F
129	19	49	2.3	F
	20	108	1.0	F
	21	210	1.1	F
130	19	88	2.2	F
	20	79	0.9	F
	21	114	1.1	F
145	4	118	1.0	F
	5	155	1.1	E
	6	125	1.0	F
154	1	155	0.6	F
	2	117	0.9	F
	3	40	2.1	F
158	1	115	0.7	F
	2	144	3.3	F
	3	148	3.0	F
186	1	119	0.7	F
	2	143	1.1	D
	3	153	1.3	E

Table 4-24. METEOROLOGICAL CONDITIONS FOR 3-HOUR PERIODS ANALYZED IN TRAJECTORY ANALYSIS (concluded)

Day	Hour	Wind Direction (Deg)	Windspeed (m/sec)	Stability Class
220	7	120	1.5	F
	8	123	2.0	F
	9	153	3.1	D
234	22	337	1.7	F
	23	112	1.0	F
	24	256	1.3	F
241	22	125	0.9	F
	23	140	0.7	F
	24	155	0.9	F
280	19	119	1.0	F
	20	144	1.3	E
	21	179	2.2	F
284	4	68	1.2	F
	5	114	1.1	F
	6	147	1.6	D
307	1	113	0.7	F
	2	120	0.9	F
	3	20	0.9	D

Table 4-25. METEOROLOGICAL CONDITIONS FOR 24 HOUR PERIOD ON DAY 112 ANALYZED IN TRAJECTORY ANALYSIS

Day	Hour	Wind Direction (Deg)	Windspeed (m/sec)	Stability Class
112	1	112	1.43	F
	2	124	0.80	F
	3	135	0.63	D
	4	40	0.72	D
	5	322	1.34	F
	6	1	0.89	F
	7	28	1.16	F
	8	122	0.72	A
	9	344	1.25	A
	10	347	1.83	A
	11	4	2.19	A
	12	5	2.28	A
	13	312	3.13	B
	14	285	2.37	A
	15	266	5.41	C
	16	307	6.03	D
	17	5	8.00	D
	18	1	7.51	D
	19	23	5.85	D
	20	22	5.77	D
	21	35	0.98	F
	22	23	0.67	F
	23	345	0.76	F
	24	310	2.01	E

Table 4-26. METEOROLOGICAL CONDITIONS FOR 24-HOUR PERIOD ON DAY 145 ANALYZED IN TRAJECTORY ANALYSIS

Day	Hour	Wind Direction (Deg)	Windspeed (m/sec)	Stability Class
145	1	36	1.03	D
	2	31	1.16	F
	3	9	0.80	F
	4	118	0.98	F
	5	155	1.12	E
	6	125	1.03	F
	7	73	0.76	F
	8	4	1.30	A
	9	348	1.34	A
	10	314	1.07	A
	11	156	3.58	A
	12	141	5.32	C
	13	173	3.84	B
	14	163	6.39	C
	15	177	3.53	E
	16	136	2.86	F
	17	205	2.82	F
	18	175	3.89	E
	19	168	6.08	D
	20	170	4.02	D
	21	191	1.70	F
	22	65	1.47	F
	23	90	2.46	D
	24	84	1.25	F

Table 4-27. METEOROLOGICAL CONDITIONS FOR 24-HOUR PERIOD ON DAY 154 ANALYZED IN TRAJECTORY ANALYSIS

Day	Hour	Wind Direction (Deg)	Windspeed (m/sec)	Stability Class
154	1	155	0.58	F
	2	177	0.89	F
	3	40	2.15	F
	4	103	2.15	E
	5	110	3.98	E
	6	144	2.50	F
	7	131	2.90	E
	8	142	1.47	D
	9	162	1.92	D
	10	115	1.07	A
	11	167	3.84	A
	12	159	6.26	C
	13	179	2.95	C
	14	52	3.22	B
	15	32	2.90	D
	16	45	5.01	D
	17	63	4.51	D
	18	119	3.40	F
	19	169	1.65	E
	20	202	1.56	F
	21	180	2.82	F
	22	149	1.61	F
	23	168	3.98	F
	24	171	5.36	D

Table 4-28. METEOROLOGICAL CONDITIONS FOR 24-HOUR PERIOD ON DAY 162 ANALYZED IN TRAJECTORY ANALYSIS

Day	Hour	Wind Direction (Deg)	Windspeed (m/sec)	Stability Class
162	1	137	2.50	E
	2	137	2.90	D
	3	117	1.79	E
	4	99	1.92	D
	5	132	3.17	E
	6	154	6.03	E
	7	162	7.69	E
	8	170	7.02	E
	9	179	7.24	D
	10	187	6.12	D
	11	183	2.82	A
	12	149	0.89	C
	13	291	1.61	A
	14	290	1.12	A
	15	19	2.15	D
	16	113	1.52	F
	17	289	1.12	D
	18	349	1.83	D
	19	9	0.89	F
	20	125	1.61	E
	21	132	1.43	E
	22	147	2.32	F
	23	79	2.10	E
	24	131	6.48	D

Table 4-29. METEOROLOGICAL CONDITIONS FOR 24-HOUR PERIOD ON DAY 220 ANALYZED IN TRAJECTORY ANALYSIS

Day	Hour	Wind Direction (Deg)	Windspeed (m/sec)	Stability Class
220	1	175	5.45	F
	2	161	4.60	F
	3	101	2.01	E
	4	60	2.50	F
	5	51	2.59	F
	6	125	1.21	F
	7	120	1.52	F
	8	123	1.97	F
	9	153	3.08	D
	10	151	1.07	C
	11	155	3.08	A
	12	173	5.63	C
	13	193	6.03	C
	14	191	8.94	D
	15	173	7.73	C
	16	162	7.95	D
	17	134	7.06	D
	18	116	5.81	E
	19	106	3.31	F
	20	92	5.54	D
	21	86	8.09	D
	22	84	8.49	D
	23	92	8.13	D
	24	114	8.63	D

Table 4-30. METEOROLOGICAL CONDITIONS FOR 24-HOUR PERIOD ON DAY 256 ANALYZED IN TRAJECTORY ANALYSIS

Day	Hour	Wind Direction (Deg)	Windspeed (m/sec)	Stability Class
256	1	109	1.03	D
	2	150	0.45	E
	3	150	0.45	E
	4	350	0.45	D
	5	350	0.45	D
	6	295	0.40	F
	7	57	0.22	E
	8	121	0.49	B
	9	100	0.89	D
	10	27	1.43	A
	11	322	1.79	D
	12	256	1.16	A
	13	313	1.50	A
	14	10	1.83	A
	15	162	2.46	A
	16	160	2.90	F
	17	160	2.90	F
	18	69	3.75	D
	19	69	3.75	D
	20	62	4.07	F
	21	56	3.80	F
	22	38	1.43	F
	23	24	1.88	E
	24	324	2.37	D

Table 4-31. METEOROLOGICAL CONDITIONS FOR 24-HOUR PERIOD ON DAY 307 ANALYZED IN TRAJECTORY ANALYSIS

Day	Hour	Wind Direction (Deg)	Windspeed (m/sec)	Stability Class
307	1	113	0.67	F
	2	120	0.89	F
	3	20	0.85	D
	4	87	1.21	F
	5	83	1.97	F
	6	92	1.79	F
	7	115	0.80	A
	8	131	1.16	A
	9	194	1.65	A
	10	203	2.50	A
	11	231	3.71	A
	12	212	3.89	B
	13	250	5.05	C
	14	246	5.94	C
	15	252	6.84	C
	16	237	6.52	D
	17	251	9.47	D
	18	257	8.45	D
	19	225	8.04	D
	20	242	4.96	E
	21	246	4.42	D
	22	286	3.44	D
	23	353	4.78	F
	24	279	3.04	D

for each of the time periods evaluated are provided in Appendix A. In general, high 24-hour average concentrations were caused by averaging several high 1-hour concentrations during that 24-hour time period. In most instances, these 24-hour concentrations were characterized by nonpersistent meteorological conditions. In fact, the maximum number of consecutive hours in a 24-hour averaging period that significantly contributed to a Class I increment exceedance in Jarbidge Wilderness Area was 3 hours. In all cases, there were intervening periods with meteorological conditions that would tend to additionaly disperse and transport the plume away from Jarbidge. These intervening hours with changes in wind direction, windspeed, and stability would likely cause additional dispersion and do not contribute to the high 24-hour average concentrations. In addition, stable atmospheric conditions (F stability) necessary to cause high concentrations with wind directions towards Jarbidge (between 113 and 133 degrees) only persist for a maximum of 3 hours during any of the 24-hour periods evaluated. The model assumes transport to Jarbidge is instantaneous (i.e., the plume travels the 75 km to Jarbidge in 1 hour). However, in all cases where the 24-hour Class I increment was exceeded, the plume would have traveled only a fraction of the distance to Jarbidge Wilderness Area since persistence of wind direction, windspeed, and stability do not occur for sufficient duration. In some cases, plume material would have to be transported up and over significant terrain barriers in order to reach Jarbidge, and this is unlikely to occur during these persistent stable conditions. If it did, additional topographically induced turbulance not accounted for in the model would likely enhance dispersion.

High 3-hour average concentrations, although characterized by 3 hours of persistence of wind direction towards Jarbidge (between 113 and 133 degrees) in one case, could not traverse 75 km during the 3-hour time span since the windspeeds needed to transport the plume that distance were insufficient. In most of the 3-hour trajectories analyzed, only 1 hour significantly contributed to the calculation of the 3-hour average concentrations at Jarbidge. Again, this occurs because the model assumes instantaneous transport to Jarbidge.

The maximum number of consecutive hours characterized by stable conditions (F stability) with a wind direction that would transport the plume towards Jarbidge is 3 hours. Three hours is also the maximum number of consecutive hours with a persistent wind direction towards Jarbidge, independent of stability, that occurred in the 1-year meteorological data set used for air quality modeling. Inspection of Tables 4-24 through 4-31 for the 3- and 24-hour time periods, shows that day 220 represents the period of maximum persisent meteorological conditions, namely F stability with a wind direction between 113 and 133 degrees, a necessary condition to transport the plume in the direction of Jarbidge. It is the only period where persistence of wind direction needed to transport the plume towards Jarbidge is maintained for 3 hours. All other 3- and 24-hour modeled Class I exceedances were characterized by nonpersistent meteorological conditions (i.e., the wind direction needed to transport the plume towards

Jarbidge only occur for 1 or 2 consecutive hours and are often separated by several hours of wind directions that would transport the plume away from Jarbidge). . For example, the 24-hour concentration on day 154 was caused by meteorological conditions during hours 5, 10, and 18. In between each of these hours, the changes in meteorology would tranport the plume in a direction other than Jarbidge and the plume would be further dispersed by the changes in stability during these intervening hours. Inspection of each table for each averaging period will show the lack of persistence needed to tranpsort the plume to Jarbidge.

In summary, from the RTDM modeling sixteen 3-hour and seven 24-hour periods had modeled concentrations that were above or near their respective increments. For each of these periods the plume trajectory was graphically plotted. The resulting trajectories for each period are shown in Appendix A. Each of the trajectories for the 3-hour averaging period shown in Appendix A also show the outline of Jarbidge Wilderness Area and the location of the exceedance. As can be readily seen from these trajectories that in all cases the plume remains at considerable distance from the receptor in Jarbidge, demonstrating that the concentrations computed by RTDM were unrealistically over predicted due to the inability of the plume to reach Jarbidge. Inspection of the seven 24-hour trajectories shown in Appendix A shows that the plume would not be transported directly to the receptor where the modeled exceedance occurred. Although there were some days where the plume would be transported towards Jarbidge, there were not a sufficient number of hours of stable meteorological conditions (when maximum impacts occur) to create as large an impact as was computed.

For the purposes of the increment analysis of the impacts of TSPP on Jarbidge Wilderness Area, trajectory analyses have shown that the maximum concentration increase (increment consumption) from TSPP emissions would be less than the allowable increment. Table 4-32 provides the maximum short-term ground-level SO_2 concentrations from TSPP in Jarbidge Wilderness Area for those periods remaining that were not screened by the trajectory analysis. Figure 4-3 also shows the locations of the maximum modeled short-term concentrations provided in Table 4-32.

As part of the air quality analysis for the PSD permit application, further air quality modeling for evaluating Class I increments may be performed.

4.5.3 Air Quality Related Values (AQRVs)

As discussed in Section 2.3.2, the USFS has identified the following AQRVs as being of potential concern in the vicinity of the proposed TSPP project: water, flora, fauna, and visibility (USFS 1989a). Sensitive receptors for each AQRV are lake alkalinity for water, lichens for flora, macrobiotic aquatic insects for fauna, and reduction in visibility (visual range) for visibility.

These limits are used as indicators of impact significance in Jarbidge Wilderness Area and other wilderness areas and wilderness study areas of

Table 4-32. MAXIMUM PREDICTED SHORT-TERM GROUND-LEVEL SO_2 CONCENTRATIONS FROM TSPP (EIGHT UNITS IN OPERATION) IN JARBIDGE WILDERNESS AREA AFTER EVALUATION BY TRAJECTORY ANALYSIS

Averaging Period	Concentration Increase Due To Project ($\mu g/m^3$)	Class I[a] Increment ($\mu g/m^3$)
3-Hour	19.2	25
24-Hour	4.4	5

[a] Short-term PSD increments (24 hours or less) are not to be exceeded more than once per year, at any location.

concern (Table 2-3). Since these limits of acceptable change are related to visibility and acid deposition impacts, they are discussed with respect to the proposed TSPP in the following sections.

4.5.3.1 Visibility. Plume emissions, especially NO_x and SO_2, can affect visibility in two primary ways: first, by contributing to the problem of "regional haze," the general reduction in all directions of the visibility (perception, contrast, and color accuracy) of distant landmarks; second, by "plume blight," where a plume of emitted material is highly evident visually, by contrast with blue sky or background terrain, or by degradation of terrain/sky contrast as viewed through the plume. At large distances, greater than 100 km, layered haze attributable to specific sources has not been observed (Latimer 1989b).

A major concern in visibility studies is the impact of new facilities on "viewsheds," or vistas and perspectives, from Class I areas, as specified in the Clean Air Act Amendments of 1977. The Class I area closest to the project site is Jarbidge Wilderness to the northwest. A detailed visibility analysis at Jarbidge Wilderness was performed for potential effects of emissions from the proposed TSPP. In addition to this detailed analysis, less detailed visibility analyses were carried out for other proposed wilderness areas, wilderness study areas.

As discussed in Section 3.2.3, upper level winds in the region are predominantly westerly, while surface level winds are more variable due to localized terrain features. Once emitted, SO_2, NO_x, and PM can be transported for long distances. Long range transport of these pollutants may have an effect on visibility in Class I areas beyond 100 km from TSPP; therefore, additional visibility analyses were performed to evaluate possible visibility-degrading effects of TSPP emissions on these areas. The primary pollutants of concern with respect to visibility degradation are NO_x and secondary fine PM formed from gas-to-particulate transformation of SO_2 and NO_x. Due to the high level of control of PM from the stacks, their effect on visibility is less important.

Visibility Impacts in Jarbidge Wilderness Area. Jarbidge Wilderness Area, along with other wilderness areas of concern in the region, has been identified as an area where potential plume visibility impacts area of concern. A visibility analysis was carried out to identify the potential magnitude and frequency distribution of plume visual impacts from the proposed TSPP on Jarbidge Wilderness Area.

The analysis was carried out using the EPA plume visibility model PLUVUE and the techniques and guidance provided in the recently revised "Workbook for Plume Visual Impact Screening and Analysis" (EPA 1988d). The PLUVUE model was used to calculate the optical effects of power plant emissions after they have been transported, dispersed, chemically converted, and deposited. Based on meteorological measurements made at the TSPP site for the period June 15, 1981 to June 14, 1982 (note that of a total of 8760 hours available for the year, 64 hours were missing), a joint frequency distribution of windspeed and wind direction at 100 meters, and stability at 10 meters, was used to estimate the frequency with which the proposed power plant emissions would be carried toward the wilderness area. By combining the modeled magnitudes of plume visual impact with the frequencies of occurrence of worst-case dispersion conditions, an analysis of visual impact magnitude and frequency is possible. Such an analysis is called Level-3 plume visibility analysis, the most detailed of three levels of visibility screening recommended by the EPA (1988d).

Figure 2-1 shows the location of Jarbidge Wilderness Area relative to the proposed TSPP site. Jarbidge is a mandatory PSD Class I area, which is afforded visibility protection by Sections 165 and 169A of the Clean Air Act. In the Air Resource Management Program (USFS 1987b) for Jarbidge Wilderness Area, the USFS has established a LAC for visibility of 5 percent visibility change.

Jarbidge Wilderness Area is approximately 75 km (47 mi) northwest of the TSPP site. Terrain slopes upward from the TSPP site (at approximately 5700 ft msl) to the Class I area (with peaks higher than 10,000 ft msl). Thus, stable drainage flows would not be carried from the proposed plant TSPP site to the Class I area. The Class I area's longest axis (approximately 35 km long) runs in a north-northeast to south-southwest direction from Biroth Ridge at the northeast corner of the wilderness area, through Mary's River Peak (elevation 10,565 ft msl), to the southwest corner of the wilderness area. The short axis of the wilderness area (approximately 15 km wide) lies in the east-southeast to west-northwest direction. The line of sight between Biroth Ridge and Mary's River Peak is a view of USFS-expressed interest. The visibility for this line of sight is currently being monitored.

The azimuths from the TSPP site to the Class I area range from 293 to 313 degrees. The portion of the wilderness closest to the proposed TSPP site is the southeast corner, approximately 75 km distant from the TSPP site. The wind directions that would carry TSPP emissions toward the wilderness subtend a 20 degree angle (113 to 133 degrees). This constitutes 46 percent of the east-southeast cardinal wind direction sector and 43 percent of the southeast sector. The southeast corner is also located roughly in the center of the angle subtending the Class I area.

This southeast corner of the Class I area was selected as the observer location for the Level-3 plume visibility analysis because impacts at this location would be expected to be worse than at other locations in the Class I area because:

- The southeast corner is closest to the TSPP site, thus dispersion would be minimal at this location.
- This corner is relatively low in elevation, allowing the observer to view horizontally across the plume, thus maximizing the plume cross section along the line of sight. Observers at higher eleva-

tions (e.g., Biroth Ridge or Mary's River Peak) would be looking down on the plume; thus, impacts would be less for these locations.

- At other locations, plume material would have to be transported up and over significant terrain barriers. It is unlikely that this would occur under the worst-case stable conditions. If it did, topographically induced turbulence would likely enhance dispersion.
- At this southeast corner, plume centerline impacting the wilderness area would be relatively close to the observer since this corner is in the middle of the angle subtending the Class I area. Plume visual impacts are larger when the plume material is relatively close to the observer.

Discussed below in the following sections are descriptions of the analysis of meteorological conditions, and the selection of worst-case dispersion conditions and the estimation of their frequency of occurrence; the PLUVUE model calculations for the selected dispersion conditions; and the frequency of occurrence of dispersion conditions along with the plume visual impact calculations to estimate the frequency of occurrence of plume visual impacts in Jarbidge.

Dispersion Conditions. The magnitude of plume visual impact is a function of the concentration of optically active species along the observer's line of sight. This concentration is greatest for lines of sight through the plume centerline and for light-wind, stable conditions. Thus, for the analysis of plume visual impacts, such worst-case dispersion conditions are of interest. Wind directions between 113 and 133 degrees would transport emissions between the azimuths of 293 and 313 degrees in the direction of Jarbidge Wilderness Area. As discussed previously, these wind azimuths constitute 46 percent of the east-southeast cardinal wind sector and 43 percent of the southeast sector. If these conditions persisted sufficiently long, TSPP emissions would be transported into the Class I area.

The precise calculation of the frequency of occurrence of plume transport into Jarbidge Wilderness Area would require sophisticated trajectory modeling based on a temporally and spatially varying windfield. Since such measurements are not available, approximations suggested by the EPA Visibility Workbook were made for the purposes of this plume visibility analysis. First, as recommended by the EPA Workbook, if transport times to the Class I area are greater than 12 hours for the given windspeed, it is assumed that the stable plume is not transported into the area. Stable conditions rarely persist longer than 12 hours, and if they did, it is unlikely that the worst-case windspeed and wind direction would persist also. Analysis of the onsite meteorological data for the TSPP site shows that the maximum number of consecutive hours of stable conditions with the wind blowing towards Jarbidge Wilderness Area was 3 hours. As discussed in Section 4.5.2, transport of the TSPP plume to Jarbidge Wilderness would be unlikely. The Level-3 visibility analysis requires the use of the joint frequency distribution of windspeed, wind direction, and stability, which does not account for persistence of meteorological potential conditions and therefore should lead to overprediction of potential visual impacts. Second, for conservatism, no credit is taken for the fact that Jarbidge Wilderness Area is at a higher elevation than the TSPP site. In actuality, flows might be diverted away from the Class I area because of terrain blockage and drainage flows.

As discussed in Section 3.2.3, the prevailing wind direction at the 100-meter level is from the west through south quadrant, wind direction that would carry TSPP emissions away from the Class I area. The portion of the east-southeast and southeast winds at 100 m (46 percent of the ESE and 43 percent of the SE winds) which would carry emissions to Jarbidge Wilderness Area occurs 2.2 percent of the time, much less frequently than the westerly and southwesterly winds.

The complete joint frequency distribution of windspeed, wind direction, and stability measured at the proposed TSPP site was used to compile the data summarized in Table 4-33. This table shows the hours per year (based on the 8696 hours of data used for modeling available from June 15, 1981 to June 14, 1982 TSPP site data) of various windspeed, wind direction, and stability combinations for various times of the day and seasons. The hours 0100 to 0600 were selected to represent dispersion conditions near dawn, the time of expected worst-case impacts. The times 0700-1200 and 1300-1800 were selected to represent impacts in the morning and midday and in the afternoon, respectively. The wind directions summarized are for the portions of the south-southeast and southeast wind sectors that would transport emissions directly toward the Class I area. These frequencies were used in conjunction with the plume visual impacts calculated to estimate the frequency of occurrence of plume visual impact and visual range reduction.

Magnitude of Plume Visual Impacts. The EPA plume visibility model PLUVUE (Johnson et al. 1980) as recently modified for application on PCs (Richards and Hammarstrand 1988), was applied to the TSPP emissions and Jarbidge Wilderness Area geometry.

Inputs were chosen largely from default model specifications. The modeled emissions (37.7, 94.3, and 3.2 tons/day for SO_2, NO_x, and PM, respectively) are the annual average emissions at the maximum project level (eight generating units, 2000 MW). In addition, two other cases were modeled to access the change in visibility impacts as the number of units increased from one to eight. The additional cases modeled were for one and four generating units in operation. Emissions for these cases were proportionally reduced from the eight unit cases.

Table 4-33. JOINT FREQUENCY OF WIND SPEED, WIND DIRECTION, AND STABILITY AT THOUSAND SPRINGS POWER PROJECT SITE IN NEVADA FOR WIND DIRECTIONS THAT WOULD CARRY EMISSIONS TO JARBIDGE WILDERNESS AREA

			Number of Hours Out of Total No. of Hours Per Year Of: 8696										
			Windspeed Category (m/sec)										
Season	Time	Atmospheric Stability	0-1	1-2	2-3	3-4	4-5	5-6	6-7	>7	Total	Average Windspeed (m/sec)	Percent of Total Hours
All	All	All	19.5	34.5	28.5	18.4	20.2	16.8	17.6	20.3	175.89	3.8	2.0
Summer	1-6	A	0.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.29	1.2	0.0
		B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		D	0.9	0.0	0.9	0.0	0.4	0.0	0.4	0.0	2.61	2.8	0.0
		E	0.9	0.9	0.5	0.0	0.9	0.0	0.4	0.4	3.96	3.3	0.0
		F	0.9	0.9	1.8	0.9	0.4	0.4	0.0	0.0	5.25	2.6	0.1
Summer	7-12	A	0.4	1.3	1.7	0.4	0.0	0.0	0.0	0.0	3.90	2.1	0.0
		B	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.46	1.5	0.0
		C	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.46	6.5	0.0
		D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
Summer	13-18	A	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.43	2.5	0.0
		B	0.0	0.0	0.0	1.4	1.8	0.0	0.0	0.0	3.13	4.1	0.0
		C	0.0	0.0	0.0	0.0	1.4	1.3	2.7	0.0	5.31	5.7	0.1
		D	0.0	0.0	0.0	0.0	0.0	0.9	0.9	2.6	4.42	7.5	0.1
		E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		F	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.46	2.5	0.0

Table 4-33. JOINT FREQUENCY OF WIND SPEED, WIND DIRECTION, AND STABILITY AT THOUSAND SPRINGS POWER PROJECT SITE IN NEVADA FOR WIND DIRECTIONS THAT WOULD CARRY EMISSIONS TO JARBIDGE WILDERNESS AREA (continued)

			Number of Hours Out of Total No. of Hours Per Year Of: 8696										
			Windspeed Category (m/sec)										
Season	Time	Atmospheric Stability	0-1	1-2	2-3	3-4	4-5	5-6	6-7	>7	Total	Average Windspeed (m/sec)	Percent of Total Hours
Fall	1-6	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		D	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.86	2.5	0.0
		E	0.9	1.4	1.4	0.9	0.0	0.0	0.0	0.0	4.48	2.0	0.1
		F	2.7	2.2	0.4	0.4	0.0	0.0	0.0	0.0	5.77	1.3	0.1
Fall	7-12	A	1.3	1.8	0.0	0.0	0.0	0.0	0.0	0.0	3.10	1.1	0.0
		B	0.9	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.29	0.8	0.0
		C	0.0	0.5	0.4	0.0	0.5	0.4	0.5	0.0	2.24	4.1	0.0
		D	0.0	0.4	0.0	0.9	0.0	0.0	0.0	0.0	1.32	2.8	0.0
		E	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.43	2.5	0.0
		F	0.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.32	1.2	0.0
Fall	13-18	A	0.0	0.0	0.4	0.4	0.0	0.0	0.0	0.0	0.86	3.0	0.0
		B	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.46	4.5	0.0
		C	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.46	5.5	0.0
		D	0.0	0.0	0.0	0.5	3.9	3.1	2.7	1.8	11.94	5.8	0.1
		E	0.0	0.4	0.9	0.4	0.4	0.0	0.0	0.4	2.61	3.8	0.0
		F	0.0	0.5	0.4	0.5	0.5	0.0	0.0	0.0	1.81	3.0	0.0

Table 4-33. JOINT FREQUENCY OF WIND SPEED, WIND DIRECTION, AND STABILITY AT THOUSAND SPRINGS POWER PROJECT SITE IN NEVADA FOR WIND DIRECTIONS THAT WOULD CARRY EMISSIONS TO JARBIDGE WILDERNESS AREA (continued)

Season	Time	Atmospheric Stability	Number of Hours Out of Total No. of Hours Per Year Of: 8696									Average Windspeed (m/sec)	Percent of Total Hours
			Windspeed Category (m/sec)										
			0-1	1-2	2-3	3-4	4-5	5-6	6-7	>7	Total		
Winter	1-6	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		D	0.4	1.8	0.9	0.0	0.5	0.0	0.9	0.4	4.82	3.4	0.1
		E	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.86	2.5	0.0
		F	0.5	2.2	0.9	1.7	0.4	0.0	0.0	0.0	5.68	2.4	0.1
Winter	7-12	A	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.43	2.5	0.0
		B	0.5	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.89	1.5	0.0
		C	0.0	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.86	2.0	0.0
		D	0.0	0.4	0.0	0.0	0.4	0.0	0.0	0.0	0.86	3.0	0.0
		E	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.89	2.5	0.0
		F	0.0	0.9	0.5	0.4	0.4	0.0	0.0	0.0	2.24	2.7	0.0
Winter	13-18	A	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.43	3.5	0.0
		B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		C	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0	0.86	4.0	0.0
		D	0.0	0.0	1.4	0.4	0.9	0.4	0.4	0.4	3.93	4.5	0.0
		E	0.0	0.4	0.4	0.4	0.0	0.5	0.0	2.2	3.99	6.2	0.0
		F	0.0	0.9	0.9	0.0	0.0	0.0	0.4	0.0	2.15	2.9	0.0

Table 4-33. JOINT FREQUENCY OF WIND SPEED, WIND DIRECTION, AND STABILITY AT THOUSAND SPRINGS POWER PROJECT SITE IN NEVADA FOR WIND DIRECTIONS THAT WOULD CARRY EMISSIONS TO JARBIDGE WILDERNESS AREA (concluded)

			Number of Hours Out of Total No. of Hours Per Year Of: 8696										
			Windspeed Category (m/sec)										
Season	Time	Atmospheric Stability	0-1	1-2	2-3	3-4	4-5	5-6	6-7	>7	Total	Average Windspeed (m/sec)	Percent of Total Hours
Spring	0-6	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0
		C	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.43	2.5	0.0
		D	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.43	4.5	0.0
		E	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	1.72	2.0	0.0
		F	0.9	1.3	1.3	0.4	0.0	0.4	0.0	0.0	4.39	2.2	0.1
Spring	7-12	A	0.5	0.9	1.4	0.0	0.0	0.0	0.0	0.0	2.70	1.8	0.0
		B	0.0	0.0	0.0	0.5	0.4	0.0	0.0	0.0	0.89	4.0	0.0
		C	0.0	0.0	0.0	0.0	0.0	0.4	0.9	0.0	1.29	6.2	0.0
		D	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.43	5.5	0.0
		E	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.46	1.5	0.0
		F	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.46	0.5	0.0
Spring	13-18	A	0.0	0.0	0.4	0.4	0.0	0.0	0.0	0.0	0.86	3.0	0.0
		B	0.0	0.0	0.0	0.0	0.9	0.4	0.0	0.0	1.32	4.8	0.0
		C	0.0	0.0	0.0	0.4	0.0	0.4	1.3	0.0	2.15	5.7	0.0
		D	0.0	0.0	0.0	0.0	0.0	1.8	1.3	2.2	5.31	7.0	0.1
		E	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.00	5.5	0.0
		F	0.0	0.0	0.0	0.4	0.5	0.0	0.0	0.0	0.89	4.0	0.0

Level-3 visibility analysis is designed to estimate the annual frequency of occurrence of plume visual impacts. It is recommended that annual average emissions be used in the Level-3 analysis (Latimer 1989b) to obtain the most accurate estimate of the frequency of occurrence of impacts. Although one could use the maximum short-term average emission rate to obtain a larger impact, it is felt that such an approach would greatly overestimate the annual frequency of occurrence of plume visual impacts. If all the worst-case combinations of emission rates, windspeed and direction, time of day, ambient ozone, and background visual range were used, one would obtain much higher plume visual impacts than those based on more typical values. However, the probability of all such conditions occurring at the same time is quite small. Maximum short-term emission rates are recommended for the more conservative Level-1 and Level-2 plume visibility screening analyses. It is recommended for Level-3 analysis, which is designed to be more realistic, that average emisson rates, visual range, and background ozone concentrations be used, rather than extreme values.

Background visual ranges of 144 and 242 km used in the analysis were the average 50th and 90th percentile visual ranges measured as part of the IMPROVE network in Jarbidge Wilderness Area. These annual visual ranges are lower than the 50th and 90th percentile visual ranges of 177 km and 287 km measured at Craters of the Moon in Idaho and the visual ranges of 215 and 326 km measured in Great Basin National Park in Nevada. However, the Jarbidge visual range is almost identical to the visual range (geometric mean of 142 km, 50-percentile of 150 km) determined from nephelometer measurements for the 1981-1982 period at the proposed TSPP site.

Using the guidance provided in the EPA Visibility Workbook, plume visual impacts were evaluated for a range of scattering angles (the angle between the line of sight and the sun) for a plume whose centerline is half a 22.5 degree sector displaced from the observer. Horizontal lines of sight were analyzed to identify worst-case viewing conditions. Nonhorizontal lines of sight would have lower impacts associated with them. Because of the orientation of the Class I area with its major axis perpendicular to plume centerline, lines of sight perpendicular to the plume axis and along the Class I area axis were analyzed because they would intersect the most plume material.

Impacts were calculated for a downwind distance of 75 km, the minimum distance between the TSPP site and Jarbidge Wilderness Area. For the reasons stated earlier, this observer location is expected to result in worst-case plume visual impacts because it is the closest point to TSPP, it is at a relatively low elevation, allowing nearly horizontal plume viewing, and plume material does not have to be transported up and over mountains to reach this location.

Seven different worst-case dispersion conditions (combinations of atmospheric stability and windspeed) were modeled using PLUVUE to establish a range of plausible magnitudes of worst-case plume visual impacts. These conditions were selected after an examination of dispersion conditions observed at the proposed TSPP site (see Table 4-33). This range of dispersion conditions represents nearly an order of magnitude of variation in the dilution factor (defined as the product of the vertical dispersion coeffcient and the windspeed).

Tables 4-34 to 4-36 summarize the calculations for the seven dispersion conditions using the background visual ranges of 144 and 242, respectively, for one, four, and eight generating units in operation. The first column provides the PLUVUE-calculated visual range reduction for lines of sight through the plume center (note that calculated visibility parameters for eight units in operation are not linearly porportional to one unit because of the nonlinearity of the governing equations). The next several columns provide the range of plume perceptibility parameters (Delta E[L*a*b*]) calculated by the plume visibility model PLUVUE. The values of Delta E are a function of the scattering angle, with maximum impacts for small scattering angles (sun in front of the observer) and smaller impacts for scattering angles greater than 90 degrees (sun behind the observer). In all cases, the calculated plume visual impact parameters are indicative of an NO_2 plume that is darker and discolored (yellow or brown) compared to the background sky. For eight generating units in operation, the calculated visual range reduction (for lines of sight through the plume centerline) for a background visual range of 144 km ranges from 1.2 to 4.2 percent. For a background visual range of 242 km, the calculated visual range reductions, for eight generating units operating, ranged from 1.1 to 4.4 percent. These are all less than the Jarbidge LAC of 5 percent. Plume perceptibility parameter (Delta E) values for eight units in operation range from 5.4 to 15.5 for a background visual range of 144 km and from 6.9 to 18.9 for a background visual range of 242 km, indicative of plumes that could be easily perceptible. The perceptibility threshold is a Delta E of 2 (EPA 1988d). The Delta E for a plume against a viewing background can be used as an indicator of plume perceptibility and atmosphere discoloration; plumes with Delta E's less than 5 would probably be imperceptible, Delta E's between 5 and 10 would be detected as a slight discoloration by most people, and the severity of discoloration would increase with increasing Delta E.

The perceptibility of the stable plume emitted from the proposed project is characterized with the Delta E parameter. As stated in the new EPA visibility workbook (EPA 1988d), the threshold, or barely perceptible, Delta E value depends on the sensitivity of the observer, with thresholds ranging from as low as a Delta E of 0.2 for the sensitive observer in a laboratory setting, to a Delta E of 0.8 for a sensitive observer in the field, to a Delta E of 2 for a casual observer in the field. EPA has chosen a Delta E of 2 as the screening threshold for Level-1 and -2 screening. No criteria have been established for Level-3 analysis; this is done on a case-by-case basis.

Table 4-34. MAGNITUDE OF PLUME VISUAL IMPACTS OF THE THOUSAND SPRINGS POWER PLANT ON JARBIDGE WILDERNESS AREA FOR VARIOUS DISPERSION CONDITIONS, WITH ONE UNIT OPERATING

Average Background Visual Range	Dispersion Category, Windspeed	Percent Visual Range Reduction	Plume Perceptibility Parameter, Delta E(L*a*b*) Scattering Angle					
			22	45	90	135	158	180
144 km	F, 2 m/sec	0.7	5.1	4.1	3.6	3.7	3.8	3.9
	F, 3 m/sec	0.5	3.7	3.0	2.6	2.7	2.7	2.8
	E, 2 m/sec	0.4	3.0	2.4	2.1	2.1	2.2	2.2
	E, 3 m/sec	0.3	2.0	1.7	1.4	1.5	1.5	1.5
	E, 4 m/sec	0.2	1.5	1.3	1.1	1.1	1.1	1.2
	D, 2 m/sec	0.2	1.4	1.1	1.0	1.0	1.0	1.0
	E, 5 m/sec	0.2	1.2	1.1	0.9	0.9	0.9	0.9
242 km	F, 2 m/sec	0.7	6.0	5.1	4.5	4.7	4.9	5.0
	F, 3 m/sec	0.5	4.4	3.7	3.3	3.4	3.6	3.6
	F, 2 m/sec	0.4	3.5	3.0	2.6	2.7	2.8	2.9
	F, 3 m/sec	0.2	2.4	2.0	1.8	1.9	1.9	2.0
	F, 4 m/sec	0.2	1.8	1.5	1.4	1.4	1.5	1.5
	F, 2 m/sec	0.2	1.6	1.4	1.2	1.2	1.3	1.3
	E, 5 m/sec	0.1	1.5	1.2	1.1	1.1	1.2	1.2

Table 4-35. MAGNITUDE OF PLUME VISUAL IMPACTS OF THE THOUSAND SPRINGS POWER PLANT ON JARBIDGE WILDERNESS AREA FOR VARIOUS DISPERSION CONDITIONS, WITH FOUR UNITS OPERATING

Average Background Visual Range	Dispersion Category, Windspeed	Percent Visual Range Reduction	Plume Perceptibility Parameter, Delta E(L*a*b*) Scattering Angle 22	45	90	135	158	180
144 km	F, 2 m/sec	2.2	10.4	8.3	7.1	7.3	7.6	7.8
	F, 3 m/sec	1.6	8.4	6.8	5.8	6.0	6.2	6.3
	E, 2 m/sec	1.4	8.9	7.2	6.2	6.4	6.6	6.7
	E, 3 m/sec	1.0	6.9	5.6	4.8	4.9	5.1	5.2
	E, 4 m/sec	0.8	5.5	4.5	3.9	3.9	4.1	5.2
	D, 2 m/sec	0.7	5.0	4.1	3.5	3.6	3.7	3.8
	E, 5 m/sec	0.6	4.6	3.7	3.2	3.3	3.4	3.5
242 km	F, 2 m/sec	2.2	12.5	10.4	9.2	9.6	10.0	10.2
	F, 3 m/sec	1.5	10.0	8.4	7.4	7.8	8.1	8.3
	F, 2 m/sec	1.3	10.7	9.0	7.9	8.3	8.6	8.8
	F, 3 m/sec	0.9	8.2	6.9	6.1	6.4	6.6	6.7
	F, 4 m/sec	0.7	6.5	5.5	4.9	5.1	5.3	5.4
	F, 2 m/sec	0.6	5.9	5.0	4.4	4.6	4.8	4.9
	E, 5 m/sec	0.6	5.4	4.6	4.0	4.2	4.4	4.5

Table 4-36. MAGNITUDE OF PLUME VISUAL IMPACTS OF THE THOUSAND SPRINGS POWER PROJECT ON JARBIDGE WILDERNESS AREA FOR VARIOUS DISPERSION CONDITIONS, WITH EIGHT UNITS OPERATING

Average Background Visual Range	Dispersion Category, Windspeed	Percent Visual Range Reduction	Plume Perceptibility Parameter, Delta E(L*a*b*) Scattering Angle					
			22	45	90	135	158	180
144 km	F, 2 m/sec	4.2	15.5	12.3	10.5	10.8	11.2	11.6
	F, 3 m/sec	2.8	11.5	9.2	7.9	8.1	8.4	8.7
	E, 2 m/sec	2.5	12.4	10.0	8.6	8.8	9.1	9.3
	E, 3 m/sec	1.8	10.3	8.3	7.1	7.3	7.5	7.7
	E, 4 m/sec	1.4	8.9	7.2	6.2	6.3	6.5	6.7
	D, 2 m/sec	1.3	8.8	7.1	6.1	6.3	6.5	6.6
	E, 5 m/sec	1.2	7.8	6.3	5.4	5.6	5.7	5.9
242 km	F, 2 m/sec	4.4	18.9	15.6	13.7	14.3	14.9	15.3
	F, 3 m/sec	2.9	13.9	11.6	10.1	10.6	11.0	11.3
	F, 2 m/sec	1.9	15.0	12.5	11.0	11.5	12.0	12.3
	F, 3 m/sec	1.7	12.3	10.4	9.1	9.5	9.9	10.1
	F, 4 m/sec	1.3	10.6	9.0	7.9	8.2	8.6	8.8
	F, 2 m/sec	1.2	10.5	8.9	7.8	8.2	8.5	8.7
	E, 5 m/sec	1.1	9.3	7.8	6.9	7.2	7.5	7.7

To provide an idea of what the plume perceptibility parameter means subjectively, please refer to the photographs on Figure 4-4. These photographs show plumes from large coal-fired power plants similar to the proposed TSPP. The brown plumes are indicative of the visual effects caused by the NO_2 and particulate in the power plant plumes. At the time these photographs were taken, teleradiometers were used to measure the plume contrast at four wavelengths.

The plume visual impact parameters are summarized as follows:

Parameter	Figure 4-4(a)	Figure 4-4(b)
Plume Contrast C_p (λ = 0.55 μm)	-0.06	-0.31
Blue-red Ratio R^p	0.94	0.66
Plume Perceptibilty Delta E(L*a*b*)	4	20

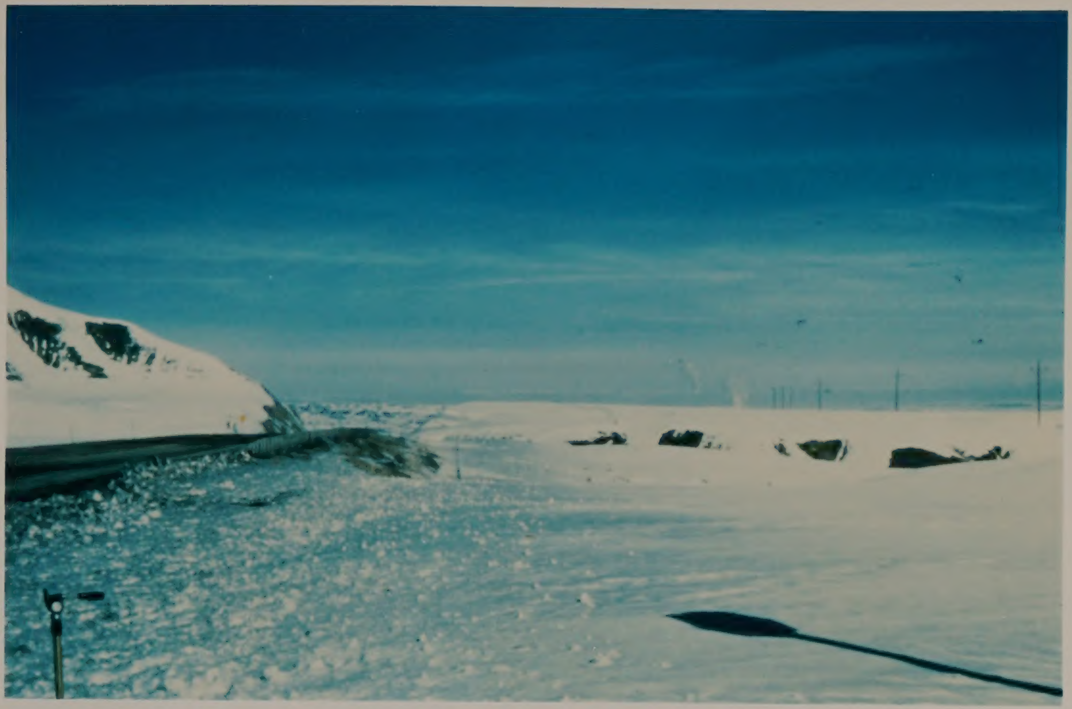
Please note that these examples provide an indication of the plume visual effects of similar emission sources for the range of worst-case impacts projected for TSPP. However, the specific orientation and viewing backgrounds at Jarbidge would be quite different from these examples.

The worst-case Delta E values occur for light-wind stable conditions and for small scattering angles. During the early morning hours when light-wind stable conditions would be most common, the sun would be in the East. For the typical views in Jarbidge, to the northeast or southwest along the major axis of the wilderness, scattering angles would be quite large for such times of day. Thus, for most viewing conditions, the maximum Delta E values (for small scattering angles) would not apply, and plume impacts would be better characterized by the smaller Delta E values corresponding to scattering angles of 90 to 180 degrees. For these scattering angles with eight units in operation the Delta E values range from 5.4 to 11.6 and from 7.9 to 15.3 for a background visual ranges of 144 and 242 km, respectively.

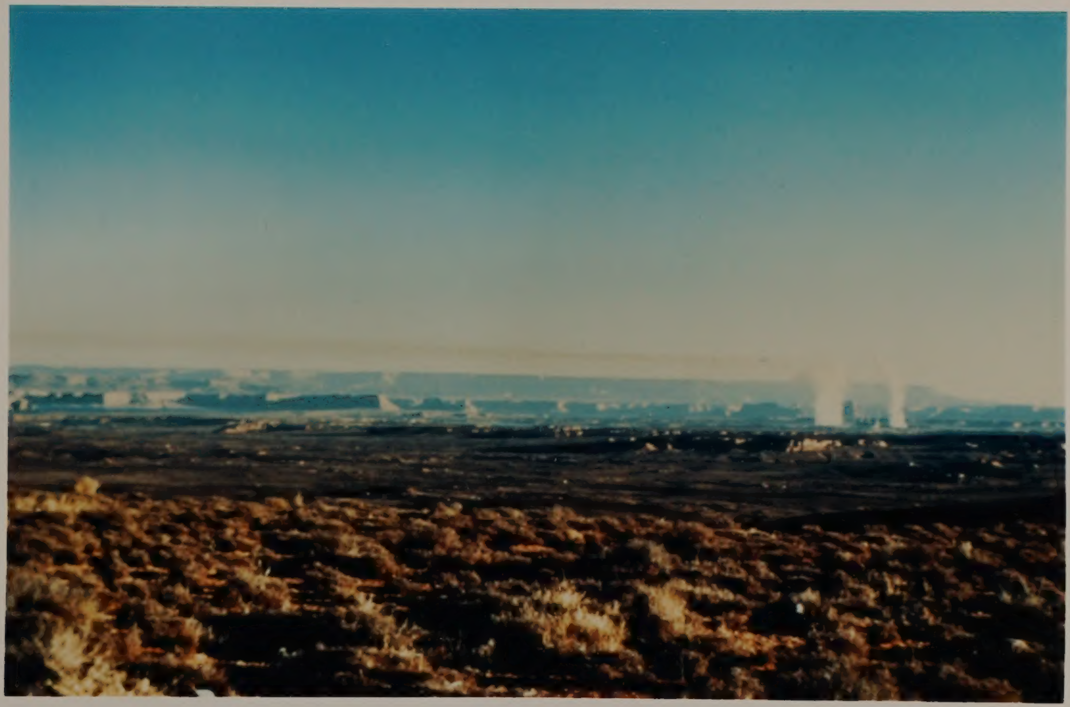
Although this analysis cannot rule out the possibility of perceptible plume impacts within Jarbidge Wilderness Area, the following discussion explains that these impacts would be quite infrequent.

Frequency of Occurrence of Plume Visual Impacts. The magnitudes of plume visual impacts (visual range reduction and Delte E) calculated with PLUVUE and summarized in Tables 4-34 to 4-36 were combined with the meteorological frequencies of occurrence of the corresponding conditions to determine the cumulative frequency of TSPP plume visual impacts in Jarbidge.

Tables 4-37 to 4-42 summarize the results of this compilation for eight units operating for background visual ranges of 144 and 242 km. Fifteen worst-case dispersion conditions are placed in ascending order of the product of σ_z and windspeed. The percentage visual range reduction and the minimum and maximum plume perceptibility parameters



(a) Plume Perceptibility (Delta E) of 4



(b) Plume Perceptibility (Delta E) of 20

Figure 4-4. Examples of Power Plant Plumes

Table 4-37. MAGNITUDE AND FREQUENCY OF OCCURRENCE OF PLUME VISUAL IMPACT IN JARBIDGE WILDERNESS AREA FROM THOUSAND SPRINGS POWER PLANT, EIGHT UNITS OPERATING, BACKGROUND VISUAL RANGE OF 144 KM, EARLY MORNING (BASED ON 0100-0600 METEOROLOGY)

Dispersion Category	Sigz*u	Percent Visual Range Reduction	Delta E(L*a*b*)		Number of Hrs/yr of Given Dispersion					Cum. No. of Hrs/yr of Given Dispersion				
			Min.	Max.	Summer	Fall	Winter	Spring	Annual	Summer	Fall	Winter	Spring	Annual
F, 1 m/sec*	85				0.9	2.7	0.5	0.9	5.0	0.0	0.0	0.0	0.0	0.0
F, 2 m/sec	170	4.2	10.5	15.5	0.9	2.2	2.2	1.3	6.6	0.9	2.2	2.2	1.3	6.6
E, 1 m/sec*	180				0.9	0.9	0.4	0.4	2.6	0.9	2.2	2.2	1.3	6.6
F, 3 m/sec	255	2.8	7.9	11.5	1.3	0.4	0.9	1.3	3.9	2.2	2.6	3.1	2.6	10.5
F, 4 m/sec	340				0.9	0.4	1.7	0.4	3.4	3.1	3.0	4.8	3.0	13.9
E, 2 m/sec	360	2.5	8.6	12.4	0.9	1.4	0.0	0.4	2.7	4.0	4.4	4.8	3.4	16.6
D, 1 m/sec*	370				0.9	0.0	0.4	0.0	1.3	4.0	4.4	4.8	3.4	16.6
F, 5 m/sec	425				0.4	0.0	0.4	0.0	0.8	4.4	4.4	5.2	3.4	17.4
F, 6 m/sec	510				0.4	0.0	0.0	0.4	0.8	4.8	4.4	5.2	3.8	18.2
E, 3 m/sec	540	1.8	7.1	10.3	0.5	1.4	0.0	0.4	2.3	5.3	5.8	5.2	4.2	20.5
F, 7 m/sec	595				0.0	0.0	0.0	0.0	0.0	5.3	5.8	5.2	4.2	20.5
F, 8 m/sec	680				0.0	0.0	0.0	0.0	0.0	5.3	5.8	5.2	4.2	20.5
E, 4 m/sec	720	1.4	6.2	8.9	0.0	0.9	0.0	0.4	1.3	5.3	6.7	5.2	4.6	21.8
D, 2 m/sec	740	1.3	6.1	8.8	0.0	0.0	1.8	0.0	1.8	5.3	6.7	7.0	4.6	23.6
E, 5 m/sec	900	1.2	5.4	7.8	0.9	0.0	0.4	0.0	1.3	6.2	6.7	7.4	4.6	24.9

* Transport time for this condition is greater than 12 hours.

Table 4-38. MAGNITUDE AND FREQUENCY OF OCCURRENCE OF PLUME VISUAL IMPACT IN JARBIDGE WILDERNESS AREA FROM THOUSAND SPRINGS POWER PLANT (EIGHT UNITS OPERATING), BACKGROUND VISUAL RANGE OF 144 KM, MORNING AND MID-DAY (BASED ON 0700-1200 METEOROLOGY)

Dispersion Category	Sigz*u	Percent Visual Range Reduction	Delta E(L*a*b*)		Number of Hrs/yr of Given Dispersion					Cum. No. of Hrs/yr of Given Dispersion				
			Min.	Max.	Summer	Fall	Winter	Spring	Annual	Summer	Fall	Winter	Spring	Annual
F, 1 m/sec*	85				0.0	0.4	0.0	0.5	0.9	0.0	0.0	0.0	0.0	0.0
F, 2 m/sec	170	4.2	10.5	15.5	0.0	0.9	0.9	0.0	1.8	0.0	0.9	0.9	0.0	1.8
E, 1 m/sec*	180				0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.0	1.8
F, 3 m/sec	255	2.8	7.9	11.5	0.0	0.0	0.5	0.0	0.5	0.0	0.9	1.4	0.0	2.3
F, 4 m/sec	340				0.0	0.0	0.4	0.0	0.4	0.0	0.9	1.8	0.0	2.7
E, 2 m/sec	360	2.5	8.6	12.4	0.0	0.0	0.0	0.5	0.5	0.0	0.9	1.8	0.5	3.2
D, 1 m/sec*	370				0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.8	0.5	3.2
F, 5 m/sec	425				0.0	0.0	0.4	0.0	0.4	0.0	0.9	2.2	0.5	3.6
F, 6 m/sec	510				0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.2	0.5	3.6
E, 3 m/sec	540	1.8	7.1	10.3	0.0	0.4	0.9	0.0	1.3	0.0	1.3	3.1	0.5	4.9
F, 7 m/sec	595				0.0	0.0	0.0	0.0	0.0	0.0	1.3	3.1	0.5	4.9
F, 8 m/sec	680				0.0	0.0	0.0	0.0	0.0	0.0	1.3	3.1	0.5	4.9
E, 4 m/sec	720	1.4	6.2	8.9	0.0	0.0	0.0	0.0	0.0	0.0	1.3	3.1	0.5	4.9
D, 2 m/sec	740	1.3	6.1	8.8	0.0	0.4	0.4	0.0	0.8	0.0	1.7	3.5	0.5	5.7
E, 5 m/sec	900	1.2	5.4	7.8	0.0	0.0	0.0	0.0	0.0	0.0	1.7	3.5	0.5	5.7

* Transport time for this condition is greater than 12 hours.

Table 4-39. MAGNITUDE AND FREQUENCY OF OCCURRENCE OF PLUME VISUAL IMPACT IN JARBIDGE WILDERNESS AREA FROM THOUSAND SPRINGS POWER PLANT (EIGHT UNITS OPERATING), BACKGROUND VISUAL RANGE OF 144 KM, AFTERNOON (BASED ON 1300-1800 METEOROLOGY)

Dispersion Category	Sigz*u	Percent Visual Range Reduction	Delta E(L*a*b*)		Number of Hrs/yr of Given Dispersion					Cum. No. of Hrs/yr of Given Dispersion				
			Min.	Max.	Summer	Fall	Winter	Spring	Annual	Summer	Fall	Winter	Spring	Annual
F, 1 m/sec*	85				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F, 2 m/sec	170	4.2	10.5	15.5	0.0	0.5	0.9	0.0	1.4	0.0	0.5	0.9	0.0	1.4
E, 1 m/sec*	180				0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	1.4
F, 3 m/sec	255	2.8	7.9	11.5	0.4	0.4	0.9	0.0	1.7	0.4	0.9	1.8	0.0	3.1
F, 4 m/sec	340				0.0	0.5	0.0	0.4	0.9	0.4	1.4	1.8	0.4	4.0
E, 2 m/sec	360	2.5	8.6	12.4	0.0	0.4	0.4	0.0	0.8	0.4	1.8	2.2	0.4	4.8
D, 1 m/sec*	370				0.0	0.0	0.0	0.0	0.0	0.4	1.8	2.2	0.4	4.8
F, 5 m/sec	425				0.0	0.5	0.0	0.5	1.0	0.4	2.3	2.2	0.9	5.8
F, 6 m/sec	510				0.0	0.0	0.0	0.0	0.0	0.4	2.3	2.2	0.9	5.8
E, 3 m/sec	540	1.8	7.1	10.3	0.0	0.9	0.4	0.0	1.3	0.4	3.2	2.6	0.9	7.1
F, 7 m/sec	595				0.0	0.0	0.4	0.0	0.4	0.4	3.2	3.0	0.9	7.5
F, 8 m/sec	680				0.0	0.0	0.0	0.0	0.0	0.4	3.2	3.0	0.9	7.5
E, 4 m/sec	720	1.4	6.2	8.9	0.0	0.4	0.4	0.0	0.8	0.4	3.6	3.4	0.9	8.3
D, 2 m/sec	740	1.3	6.1	8.8	0.0	0.0	0.0	0.0	0.0	0.4	3.6	3.4	0.9	8.3
E, 5 m/sec	900	1.2	5.4	7.8	0.0	0.4	0.0	0.0	0.4	0.4	4.0	3.4	0.9	8.7

* Transport time for this condition is greater than 12 hours

Table 4-40. MAGNITUDE AND FREQUENCY OF OCCURRENCE OF PLUME VISUAL IMPACT IN JARBIDGE WILDERNESS AREA FROM THOUSAND SPRINGS POWER PLANT (EIGHT UNITS OPERATING) BACKGROUND VISUAL RANGE OF 242 KM, EARLY MORNING (BASED ON 0100-0600 METEOROLOGY)

Dispersion Category	Sigz*u	Percent Visual Range Reduction	Delta E(L*a*b*)		Number of Hrs/yr of Given Dispersion					Cum. No. of Hrs/yr of Given Dispersion				
			Min.	Max.	Summer	Fall	Winter	Spring	Annual	Summer	Fall	Winter	Spring	Annual
F, 1 m/sec*	85				0.9	2.7	0.5	0.9	5.0	0.0	0.0	0.0	0.0	0.0
F, 2 m/sec	170	4.2	10.5	15.5	0.9	2.2	2.2	1.3	6.6	0.9	2.2	2.2	1.3	6.6
E, 1 m/sec*	180				0.9	0.9	0.4	0.4	2.6	0.9	2.2	2.2	1.3	6.6
F, 3 m/sec	255	2.8	7.9	11.5	1.3	0.4	0.9	1.3	3.9	2.2	2.6	3.1	2.6	10.5
F, 4 m/sec	340				0.9	0.4	1.7	0.4	3.4	3.1	3.0	4.8	3.0	13.9
E, 2 m/sec	360	2.5	8.6	12.4	0.9	1.4	0.0	0.4	2.7	4.0	4.4	4.8	3.4	16.6
D, 1 m/sec*	370				0.9	0.0	0.4	0.0	1.3	4.0	4.4	4.8	3.4	16.6
F, 5 m/sec	425				0.4	0.0	0.4	0.0	0.8	4.4	4.4	5.2	3.4	17.4
F, 6 m/sec	510				0.4	0.0	0.0	0.4	0.8	4.8	4.4	5.2	3.8	18.2
E, 3 m/sec	540	1.8	7.1	10.3	0.5	1.4	0.0	0.4	2.3	5.3	5.8	5.2	4.2	20.5
F, 7 m/sec	595				0.0	0.0	0.0	0.0	0.0	5.3	5.8	5.2	4.2	20.5
F, 8 m/sec	680				0.0	0.0	0.0	0.0	0.0	5.3	5.8	5.2	4.2	20.5
E, 4 m/sec	720	1.4	6.2	8.9	0.0	0.9	0.0	0.4	1.3	5.3	6.7	5.2	4.6	21.8
D, 2 m/sec	740	1.3	6.1	8.8	0.0	0.0	1.8	0.0	1.8	5.3	6.7	7.0	4.6	23.6
E, 5 m/sec	900	1.2	5.4	7.8	0.9	0.0	0.4	0.0	1.3	6.2	6.7	7.4	4.6	24.9

* Transport time for this condition is greater than 12 hours.

Table 4-41. MAGNITUDE AND FREQUENCY OF OCCURRENCE OF PLUME VISUAL IMPACT IN JARBIDGE WILDERNESS AREA FROM THOUSAND SPRINGS POWER PLANT (EIGHT UNITS OPERATING), BACKGROUND VISUAL RANGE OF 242 KM, MORNING AND MID-DAY (BASED ON 0700-1200 METEOROLOGY)

Dispersion Category	Sigz*u	Percent Visual Range Reduction	Delta E(L*a*b*)		Number of Hrs/yr of Given Dispersion					Cum. No. of Hrs/yr of Given Dispersion				
			Min.	Max.	Summer	Fall	Winter	Spring	Annual	Summer	Fall	Winter	Spring	Annual
F, 1 m/sec*	85				0.0	0.4	0.0	0.5	0.9	0.0	0.0	0.0	0.0	0.0
F, 2 m/sec	170	4.2	10.5	15.5	0.0	0.9	0.9	0.0	1.8	0.0	0.9	0.9	0.0	1.8
E, 1 m/sec*	180				0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.0	1.8
F, 3 m/sec	255	2.8	7.9	11.5	0.0	0.0	0.5	0.0	0.5	0.0	0.9	1.4	0.0	2.3
F, 4 m/sec	340				0.0	0.0	0.4	0.0	0.4	0.0	0.9	1.8	0.0	2.7
E, 2 m/sec	360	2.5	8.6	12.4	0.0	0.0	0.0	0.5	0.5	0.0	0.9	1.8	0.5	3.2
D, 1 m/sec*	370				0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.8	0.5	3.2
F, 5 m/sec	425				0.0	0.0	0.4	0.0	0.4	0.0	0.9	2.2	0.5	3.6
F, 6 m/sec	510				0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.2	0.5	3.6
E, 3 m/sec	540	1.8	7.1	10.3	0.0	0.4	0.9	0.0	1.3	0.0	1.3	3.1	0.5	4.9
F, 7 m/sec	595				0.0	0.0	0.0	0.0	0.0	0.0	1.3	3.1	0.5	4.9
F, 8 m/sec	680				0.0	0.0	0.0	0.0	0.0	0.0	1.3	3.1	0.5	4.9
E, 4 m/sec	720	1.4	6.2	8.9	0.0	0.0	0.0	0.0	0.0	0.0	1.3	3.1	0.5	4.9
D, 2 m/sec	740	1.3	6.1	8.8	0.0	0.4	0.4	0.0	0.8	0.0	1.7	3.5	0.5	5.7
E, 5 m/sec	900	1.2	5.4	7.8	0.0	0.0	0.0	0.0	0.0	0.0	1.7	3.5	0.5	5.7

* Transport time for this condition is greater than 12 hours.

Table 4-42. MAGNITUDE AND FREQUENCY OF OCCURRENCE OF PLUME VISUAL IMPACT IN JARBIDGE WILDERNESS AREA FROM THOUSAND SPRINGS POWER PLANT (EIGHT UNITS OPERATING), BACKGROUND VISUAL RANGE OF 242 KM, AFTERNOON (BASED ON 1300-1800 METEOROLOGY)

Dispersion Category	Sigz*u	Percent Visual Range Reduction	Delta E(L*a*b*)		Number of Hrs/yr of Given Dispersion					Cum. No. of Hrs/yr of Given Dispersion				
			Min.	Max.	Summer	Fall	Winter	Spring	Annual	Summer	Fall	Winter	Spring	Annual
F, 1 m/sec*	85				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F, 2 m/sec	170	4.4	13.7	18.9	0.0	0.5	0.9	0.0	1.4	0.0	0.5	0.9	0.0	1.4
E, 1 m/sec*	180				0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	1.4
F, 3 m/sec	255	2.9	10.1	13.9	0.4	0.4	0.9	0.0	1.7	0.4	0.9	1.8	0.0	3.1
F, 4 m/sec	340				0.0	0.5	0.0	0.4	0.9	0.4	1.4	1.8	0.4	4.0
E, 2 m/sec	360	1.9	11.0	15.0	0.0	0.4	0.4	0.0	0.8	0.4	1.8	2.2	0.4	4.8
D, 1 m/sec*	370				0.0	0.0	0.0	0.0	0.0	0.4	1.8	2.2	0.4	4.8
F, 5 m/sec	425				0.0	0.5	0.0	0.5	1.0	0.4	2.3	2.2	0.9	5.8
F, 6 m/sec	510				0.0	0.0	0.0	0.0	0.0	0.4	2.3	2.2	0.9	5.8
E, 3 m/sec	540	1.7	9.1	12.3	0.0	0.9	0.4	0.0	1.3	0.4	3.2	2.6	0.9	7.1
F, 7 m/sec	595				0.0	0.0	0.4	0.0	0.4	0.4	3.2	3.0	0.9	7.5
F, 8 m/sec	680				0.0	0.0	0.0	0.0	0.0	0.4	3.2	3.0	0.9	7.5
E, 4 m/sec	720	1.3	7.9	10.6	0.0	0.4	0.4	0.0	0.8	0.4	3.6	3.4	0.9	8.3
D, 2 m/sec	740	1.2	7.8	10.5	0.0	0.0	0.0	0.0	0.0	0.4	3.6	3.4	0.9	8.3
E, 5 m/sec	900	1.1	6.9	9.3	0.0	0.4	0.0	0.0	0.4	0.4	4.0	3.4	0.9	8.7

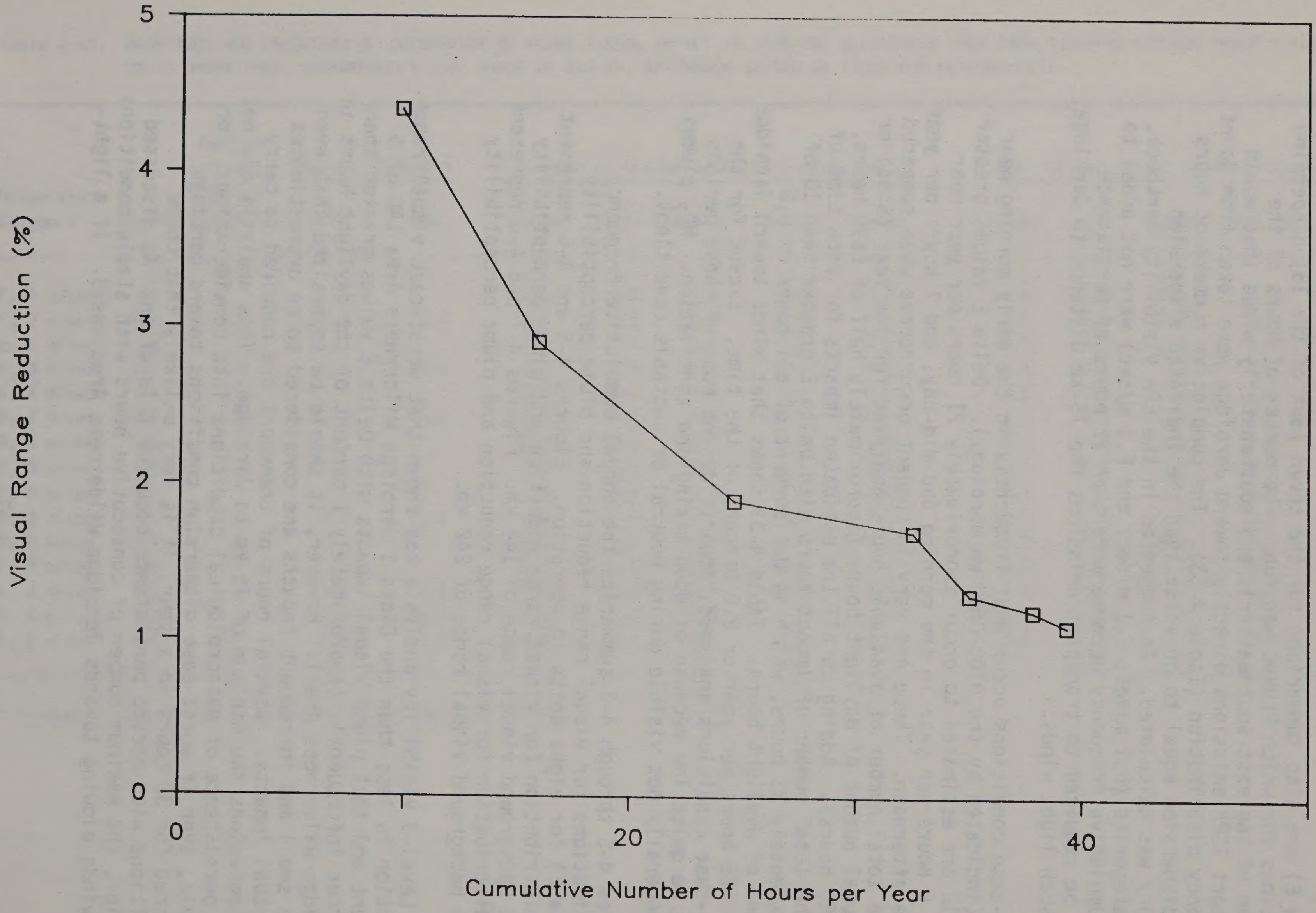
* Transport time for this condition is greater than 12 hours.

(Delta E) are also summarized for the seven (out of the 15) dispersion conditions for which PLUVUE was run. The number of hours of the portion of the east-southeasterly and southeasterly winds that would transport TSPP emissions directly toward Jarbidge were taken from joint frequency distribution (Table 4-33). The cumulative numbers of hours with dispersion equal to or worse than the indicated dispersion category was calculated. As suggested in the EPA Visibility Workbook, the categories (D,1 m/sec; E,1 m/sec; and F,1 m/sec) were not added to the cumulative frequency because more than 12 hours of persistence would be required to transport emissions the 75-km distance to Jarbidge with such light winds.

Worst-case conditions occur most frequently in the early morning near dawn (indicated by the 0100-0600 meteorology). Delta E values greater than 10 are estimated to occur approximately 21 hours per year near dawn, 5 hours per year in the morning and mid-day, and 7 hours per year in the afternoon. These are very infrequent occurrences when compared to the total number of available hours analyzed for the year (8696) or the total number of daylight hours (approximately half of 8696 hours, or 4350 hours). Adding up all the estimated impacts for each time of day the total number of impact hours with Delta E greater than 10 of approximately 33 hours, which is 0.4 percent of all hours or 0.8 percent of daylight hours. Table 4-33 shows that winds toward Jarbidge occur 176 hours per year or 2.0 percent of the time. Except for the worst-case conditions analyzed, impacts during most of these periods would be quite low because of good mixing and ventilation. NO_2 plumes are generally not visible during neutral or unstable conditions.

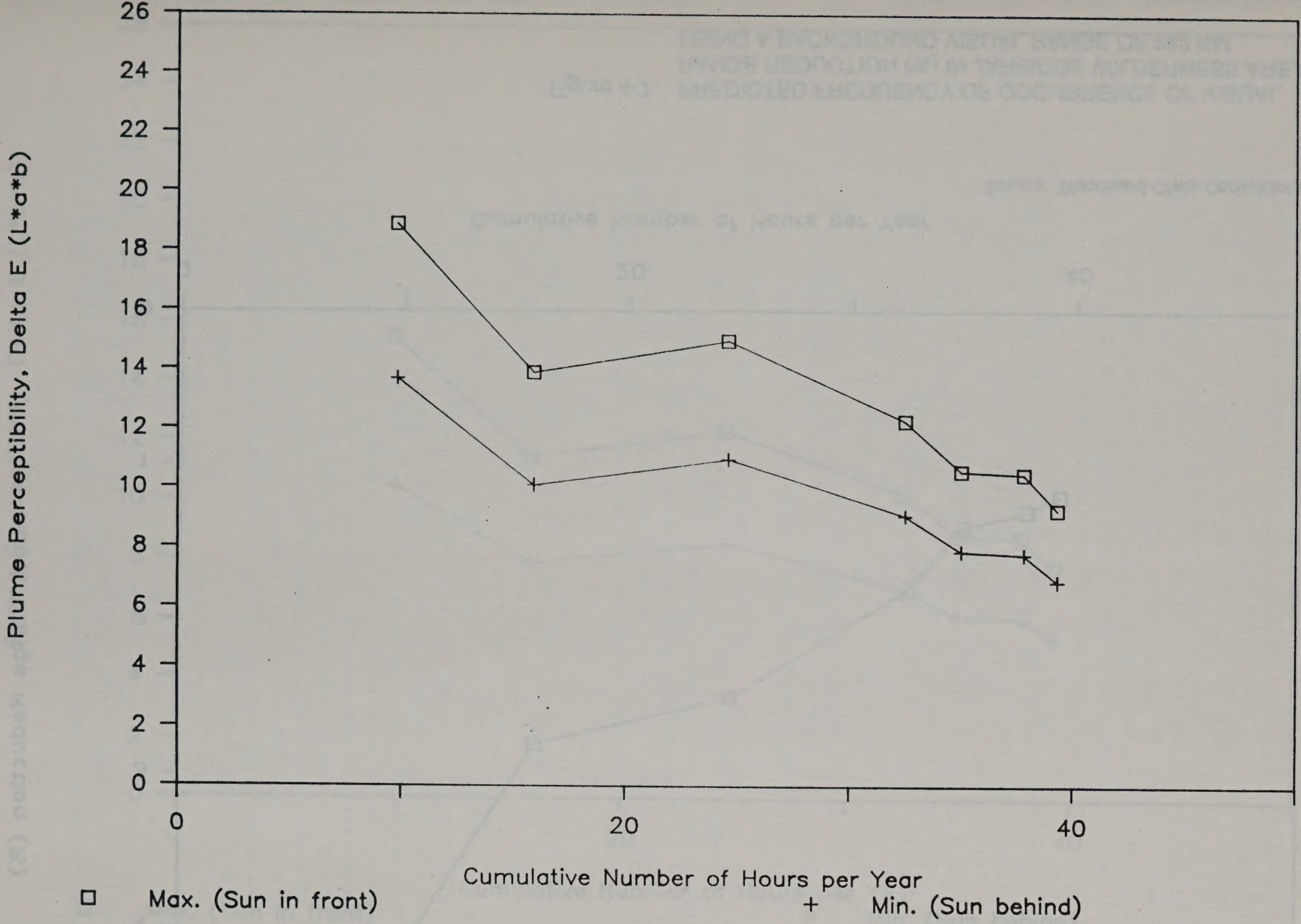
Figures 4-5 through 4-8 summarize the annual cumulative frequency distributions for visual range reduction and plume perceptibility (Delta E) for eight units in operation. Figures 4-5 and 4-6 represent the distribution for visual range reduction and plume perceptibility for a background visual range of 144 km. Figures 4-7 and 4-8 represent the distribution for visual range reduction and plume perceptibility for a background visual range of 242 km.

This Level-3 visibility analysis has shown that worst-case visual range reduction is less than the Class I Jarbidge Wilderness Area LAC of 5 percent and that plume visual impacts with Delta E values greater than 10 occur infrequently (approximately 1 percent of the daylight hours in Jarbidge Wilderness Area). However, it should be emphasized that even these small and infrequent impacts are considered to be overestimates of actual impacts. Several hours of transport are required to carry TSPP emissions the minimum of 75 km to Jarbidge. This analysis did not take persistence of meteorological conditions into consideration. For example, even if worst-case dispersion conditions toward Jarbidge occurred for 32 hours in a year, it is very unlikely that these conditions with needed persistence occurred this often. As discussed earlier, the maximum number of consecutive hours with stable conditions and winds blowing towards Jarbidge Wilderness Area was 3. If a light-



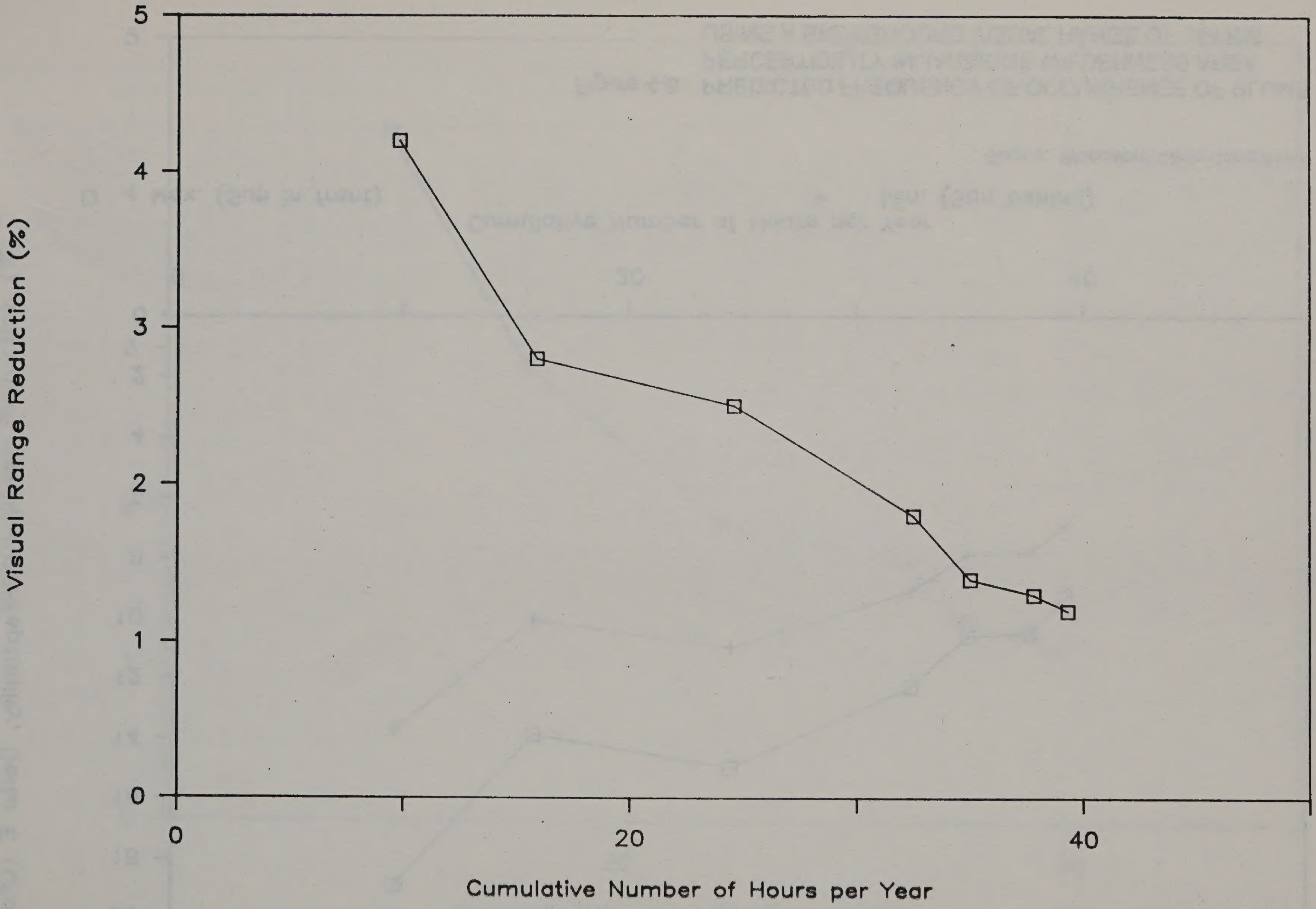
Source: Woodward-Clyde Consultants

Figure 4-5. PREDICTED FREQUENCY OF OCCURRENCE OF VISUAL RANGE REDUCTION (%) IN JARBIDGE WILDERNESS AREA USING A BACKGROUND VISUAL RANGE OF 144 KM



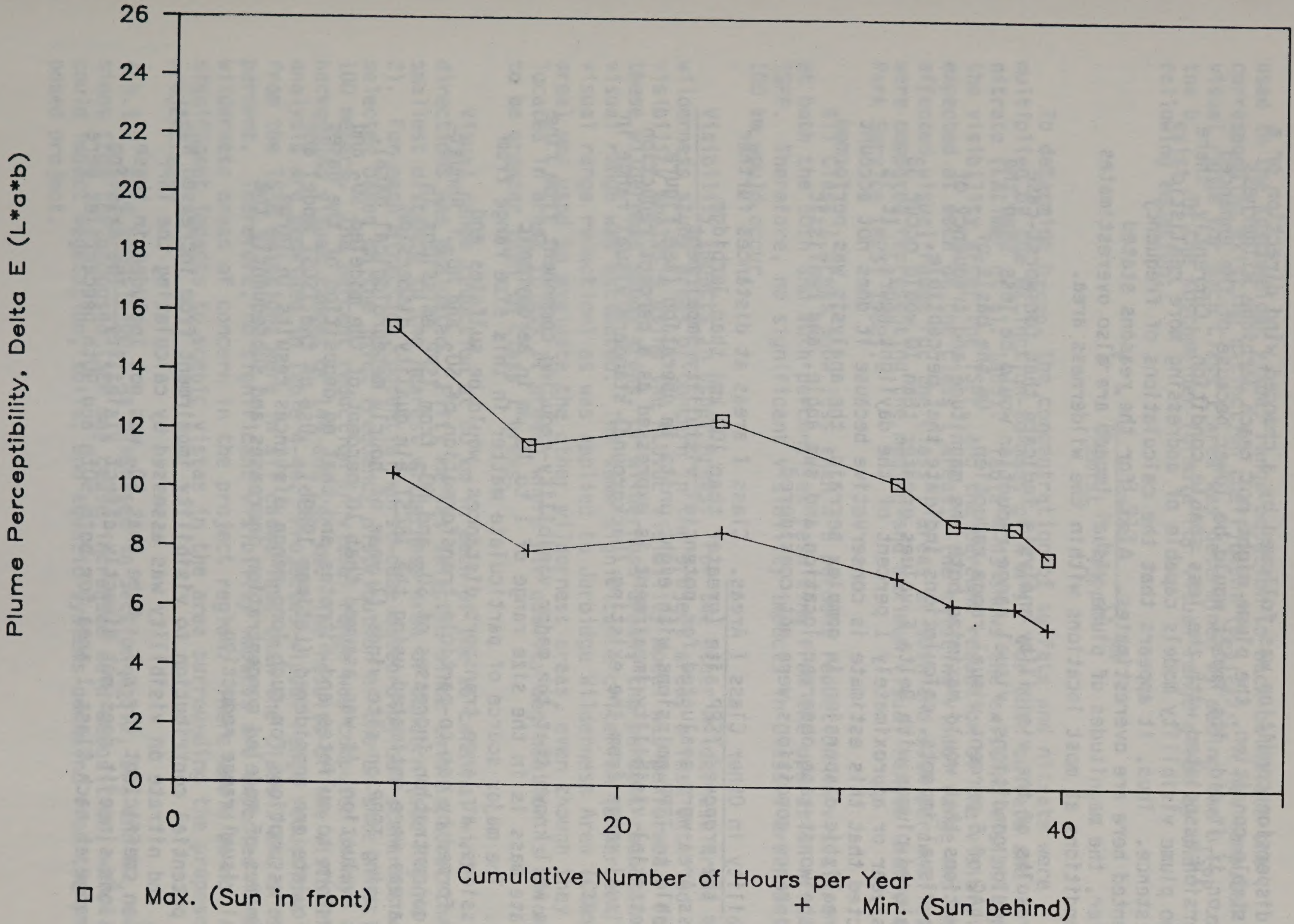
Source: Woodward-Clyde Consultants

Figure 4-6. PREDICTED FREQUENCY OF OCCURRENCE OF PLUME PERCEPTIBILITY IN JARBIDGE WILDERNESS AREA USING A BACKGROUND VISUAL RANGE OF 144 KM



Source: Woodward-Clyde Consultants

Figure 4-7. PREDICTED FREQUENCY OF OCCURRENCE OF VISUAL RANGE REDUCTION (%) IN JARBIDGE WILDERNESS AREA USING A BACKGROUND VISUAL RANGE OF 242 KM



Source: Woodward-Clyde Consultants

Figure 4-8. PREDICTED FREQUENCY OF OCCURRENCE OF PLUME PERCEPTIBILITY IN JARBIDGE WILDERNESS AREA USING A BACKGROUND VISUAL RANGE OF 242 KM

wind dispersion condition was followed by a changed wind direction or a less stable condition, the plume might not reach Jarbidge Wilderness Area, or if it did, its impact would be lower because of the enhanced dispersion associated with the less stable condition. Currently, there are no plume visibility models capable of addressing more realistic persistence. Thus, it appears that the calculations of frequency presented here are overestimates. Also, for the reasons stated earlier, the magnitudes of plume visual impact are also overestimates of conditions at most locations within the wilderness area.

The results of the visibility analysis indicate that for worst-case dispersion conditions, visual range reduction would be less than the USFS LAC of 5 percent visual range reduction. On the basis of assumptions that would maximize both the magnitude and frequency of plume visual impacts, calculations indicate that perceptible, discolored plumes with Delta E values greater than 10 would occur 33 hours/year or approximately 1 percent of the daylight hours. It is expected that this estimate is conservative because it does not account for realistic dispersion in complex terrain, the analysis was performed for the worst-case observer location and sun angle, and realistic persistence conditions were not considered.

Visibility in Other Class I Areas. Class I areas at distances further away from the proposed TSPP site (greater than 100 km) than Jarbidge Wilderness Area were evaluated for potential visibility impairment attributable to TSPP emissions with eight units in operation (see Figure 2-2). Potential visibility impairment is expressed as a percent reduction in the visual range from the existing (background) standard visual range in these areas.

It is well known that the major visibility-reducing component from fine particulate mass is in the size range of 1 to 10 μm in aerodynamic diameter. The major source of particulate matter in this size range from TSPP emissions, at large transport distances, would be sulfates and nitrates formed by gas-to-particle transformation of SO_2 and NO_2. Annual-average concentration increases of SO_2 and NO_2 from TSPP emissions in Class I areas were estimated using the ISCST air quality dispersion modeling using TSPP on-site winds (1 year of hourly meteorological data). For this evaluation, it was assumed that 10 percent of the modeled SO_2 and NO_2 transform to sulfates and nitrates and that no deposition of the gases or particulate are considered (Latimer 1989b). Use of the ISCST model and the above assumptions for such long-range distances results in large overestimates of modeled concentration increases and subsequently the potential visual range reduction.

The potential contribution to visibility impairment from increased NO_2, sulfate, and nitrate on visibility was assessed by calculating the TSPP extinction coefficient (b_{TSPP}). Note that SO_2 was not included in these calculations since it does not directly affect visibility. The existing visual range at each Class I area for both 50th and 90th percentiles were used in the Koschmeider visual range equation to back-calculate the corresponding existing extinction coefficient (b_{exist}). A new computed visual range for each Class I area was determined by adding the b_{TSPP} to the b_{exist} in the Koschmeider formula for visual range given by the following equation:

$$V_r = \frac{3.912}{(b_{exist} + b_{TSPP})}, \text{ km}$$

To determine b_{TSPP}, the concentration of sulfate and nitrate were multiplied by the extinction-to-mass of 4 m^2s^{-1} for both sulfate and nitrate (Latimer et al. 1985). Table 4-43 shows the existing visibility, the visibility after the TSPP, and the percent reduction of the visibility expected at each of the Class I areas. The existing visual range and the affected visual range for the Class I areas at 50th and 90th percentiles were compared representing the median and maximum visual ranges (National Park Service [NPS] 1988).

All Class I areas show less than a 5 percent reduction in visual range at both the 50th and 90th percentiles resulting from the operation of the TSPP. Therefore, no significant visibility impacts in Class I areas beyond 100 km would occur.

Visibility Impacts in Other Areas. For the other wilderness areas and wilderness study areas of concern in the project area, a less detailed visibility analysis using the PLUVUE visibility model was performed. For these wilderness study areas, or wilderness areas, the percent reduction in visual range was estimated. The same significance criterion (5 percent visual range reduction) as was applied to Jarbidge Wilderness Area (Class I area) was used to evaluate the other wilderness areas, even though they are located in areas (Class II areas) where air quality degradation is allowed to be greater than in Class I areas.

Visual range reduction at 50 km in each of the 16 cardinal wind directions was evaluated. Fifty km was selected since this is about the smallest distance to the nearest wilderness area of concern (see Figure 2-2). For each direction, potential worst-case meteorological scenarios were selected based on the joint frequency distribution of the on-site winds at 100 meters. The percent reduction in visual range was computed using background visual ranges of 144 and 242 km. The results of the visibility analysis are provided in Table 4-44. Projected visual range reductions from the TSPP emissions were in all cases less than the Class I LAC of 5 percent. Therefore, no significant visibility impacts are expected in the wilderness areas of concern in the project region. There would be no significant impacts to scenic vistas in the area surrounding the proposed project.

4.5.3.2 Acid Deposition. As discussed in Section 3.3.2, SO_2 and NO_x emissions from the proposed TSPP may cause increased acid deposition, which could impact vegetation, soils, and aquatic systems downwind from the proposed project.

Table 4-43. COMPUTED VISUAL RANGE REDUCTIONS AT CLASS I AREAS IN REGION AND GREAT BASIN NATIONAL PARK (8 UNITS IN OPERATION)

	Annual Average Concentration Increase From TSPP ($\mu g/m^3$)				Background Visual Range (km)		Computed Visual Range (km) With TSPP		Percent Reduction of Visual Range (km)	
Location	Sulfur Dioxide	Nitrogen Dioxide	Sulfate	Nitrate	50th Percentile	90th Percentile	50th Percentile	90th Percentile	50th Percentile	90th Percentile
IDAHO:										
Craters of the Moon National Monument	0.14	0.33	0.02	0.06	177.0	287.0	174.4	279.5	1.6	2.6
Sawtooth Wilderness	0.09	0.23	0.02	0.04	190.0	280.0	188.0	275.7	1.0	1.5
Hells Canyon Wilderness	0.05	0.12	0.01	0.02	170.0	280.0	169.2	277.9	0.5	0.8
UTAH:										
Capitol Reef National Park	0.05	0.14	0.01	0.02	179.0	258.0	178.0	255.9	0.6	0.8
Zion National Park	0.05	0.14	0.01	0.02	173.0	258.0	172.0	255.9	0.6	0.8
WYOMING:										
Bridger Wilderness	0.07	0.17	0.01	0.03	170.0	251.0	169.1	248.4	0.7	1.0
Grand Teton National Park	0.05	0.12	0.01	0.02	173.0	251.0	172.0	249.3	0.5	0.7
Teton Wilderness	0.05	0.11	0.01	0.02	173.0	251.0	172.2	249.4	0.4	0.7
Yellowstone National Park	0.06	0.15	0.01	0.03	172.0	251.0	171.2	248.7	0.6	0.9
NEVADA:										
Great Basin National Park[a]	0.07	0.17	0.01	0.03	215.0	326.0	212.8	321.7	0.9	1.3

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[a] Great Basin National Park is a Class II area.

Table 4-44. ESTIMATED VISUAL RANGE REDUCTION AT 50 KILOMETERS FROM TSPP (EIGHT UNITS) USING AVERAGE (50TH PERCENTILE) AND 90TH PERCENTILE BACKGROUND VISUAL RANGES

	Worst-Case Meteorological Conditions		Visual Range Reduction (%) Background Visual Range	
Wind Direction	Stability Class	Windspeed (m/sec)	50th Percentile 144 (km)	90th Percentile 242 (km)
N	F	3	2.8	2.9
NNE	F	2	4.2	4.4
NE	F	3	2.8	2.9
ENE	F	3	2.8	2.9
E	F	2	4.2	4.4
ESE	F	2	4.2	4.4
SE	F	3	2.8	2.9
SSE	F	3	2.8	2.9
S	F	3	2.8	2.9
SSW	F	3	2.8	2.9
SW	F	3	2.8	2.9
WSW	E	2	2.5	1.9
W	F	5	1.8	1.8
WNW	E	3	1.8	1.7
NW	E	2	2.5	1.9
NNW	F	3	2.8	2.9

The USFS has established the following Sensitivity Index to acid deposition in aquatic systems (USFS 1987b):

Sensitive	-	Alkalinity less than 200 μeq/l
Very Sensitive	-	Alkalinity less than 125 μeq/l
Ultrasensitive	-	Alkalinity less than 75 μeq/l

Water samples taken in 1986 indicated an alkalinity of 131 μeq/l in Emerald Lake and 35 μeq/l in Jarbidge Lake (USFS 1987b). Since these values suggest a potential sensitivity to acid deposition, the mechanisms by which acid deposition produces the greatest impacts need to be considered. These considerations include the phenomenon of acid shock during snowmelt in which the hydrogen ion (H^+) concentration of the first melt water may be 5 to 10 times that of the bulk snowmelt.

Based on past studies identifying areas with low buffering capacities (i.e., less than 70 μeq/l) , Emerald and Jarbidge Lakes were examined for changes in pH in accordance to a screening procedure developed by the USFS (USFS 1987a). Using this procedure, annual average SO_2 and NO_x (as NO_2) concentrations obtained from air quality modeling were first converted to expected deposition amounts, which were then used to calculate possible lake pH change based on a number of conservative assumptions. The equations and assumptions are indicated below.

The equation used to convert annual average SO_2 and NO_x concentrations to dry sulfur and nitrogen deposition rates is:

$$D = k\ (C\ v_d)$$

where:

D is the dry deposition rate in g/m^2-yr of sulfur or nitrogen.

k is a constant to convert units and account for the fractional content of sulfur in SO_2 and nitrogen in NO_2. It equals 15.77 for sulfur dry deposition and 9.46 for nitrogen dry deposition.

C is the annual average concentration of SO_2 or NO_2 in $\mu g/m^3$.

v_d is the deposition velocity, 0.01 m/sec for both SO_2 and NO_2. This is a representative deposition velocity typically used in screening assessments.

The dry deposition rate calculated above is multiplied by a factor of 2 to calculate the total deposition rate, which is assumed to have equal wet and dry deposition components. Total deposition is then inserted into the following equation to calculate the pH change in sensitive lakes:

$$\text{change in pH} = \log (A) - \log \left(A - \left(\frac{H_s + H_n}{d}\right) \times 10^{-3}\right)$$

where:

A = alkalinity in eq/l
d = measured precipitation in m
$H_s = D_s/(10 \times R_s \times 32)$ in eq/m^2
$H_n = D_n/(10 \times R_n \times 46)$ in eq/m^2
D_s = total sulfur deposition in kg/ha-yr
D_n = total nitrogen deposition in kg/ha-yr
R_s = weight of sulfur/total weight of SO_2 = 0.500
R_n = weight of nitrogen/total weight of NO_2 = 0.304

As discussed by Fox (1983), this methodology provides a worst case estimate of pH change because a most sensitive lake is used and maximal values of deposition are used; all of the SO_2 and NO_2 deposited are assumed to be available as sulfuric acid and nitric acid, thus providing the maximum $[H^+]$ possible; the soil and watershed surrounding the lake are not assumed to provide any buffering capacity for the deposition; the annual deposition of $[H^+]$ is assumed to accumulate within the snowpack and be available to the lake without any buffering within the snowmelt itself; and the lake is assumed to be of equal volume with the snowpack water equivalent and to not have any other water inputs. For watersheds which are large (in water volume) compared with the lakes, this is not necessarily a conservative assumption. Other assumptions include that all sulfur is deposited as SO_2 and nitrogen as NO_2, that H^+ neutralizes alkalinity, and that carbonate equilibrium in an aqueous solution is governed by the absorption of CO_2 from the atmosphere and the dissolution of the resulting H_2CO_3 into HCO_3^- and H^+.

The procedure described above provides a worst-case estimate of pH change. Predictions can be compared to a pH change of 0.10 to determine significance. In addition, total sulfate deposition can be compared to 5 kg/ha-yr for a further indication of potentially adverse impacts on sensitive areas with low buffering capacities.

Table 4-45 provides the results of applying the screening procedures described above to Emerald and Jarbidge Lakes. Alkalinity in Emerald Lake was previously cited as 131×10^{-6} eq/liter and in Jarbidge Lake as 35×10^{-6} eq/liter. Annual precipitation in the Jarbidge Wilderness Area is estimated as approximately 24.5 inches. Thus, using the second equation given above, pH changes for Emerald Lake and Jarbidge Lake are estimated as 0.02 and 0.06, respectively. These projected changes are lower than the LAC for Jarbidge Wilderness Area of 0.1 of a pH unit. The corresponding alkalinity changes in Emerald Lake and Jarbidge Lake are calculated as 4.45 and 4.56 μeq/l, respectively.

Total sulfur deposition due to TSPP at Emerald Lake and Jarbidge Lake estimated from air quality modeling would be 0.12 kg/ha-yr and 0.11 kg/ha-yr, respectively, and are considerably below the 5 kg/ha-yr limit. Total nitrogen deposition due to TSPP would be 0.29 and 0.28 kg/ha-yr at Jarbidge

Table 4-45. SUMMARY OF ANNUAL AVERAGE SO_2 AND NO_2 CONCENTRATIONS, DEPOSITION RATES, ALKALINITY, AND pH CHANGES FOR JARBIDGE LAKE AND EMERALD LAKE

	Annual Average Concentration			TSPP			BACKGROUND			TOTAL DEPOSITION (TSSP+BACKGROUND)			Alkalinity Change (µEQ/L)			pH Change		
Location	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	PM ($\mu g/m^3$)	Sulfur Deposition (kg/ha-yr)	Sulfate Deposition (kg/ha-yr)	Nitrogen Deposition (kg/ha-yr)	Sulfur Deposition (kg/ha-yr)	Sulfate Deposition (kg/ha-yr)	Nitrogen Deposition (kg/ha-yr)	Sulfur Deposition (kg/ha-yr)	Sulfate Deposition (kg/ha-yr)	Nitrogen Deposition (kg/ha-yr)	TSPP	Background	Total	TSPP	Background	Total
Jarbidge Lake	0.04	0.09	0.00	0.12	0.35	0.29	0.93	2.80	0.72	1.05	3.15	1.01	4.56	17.96	22.52	0.06	0.31	0.31
Emerald Lake	0.04	0.09	0.00	0.11	0.34	0.28	0.93	2.80	0.75	1.05	3.14	1.03	4.45	18.31	22.76	0.02	0.07	0.08

and Emerald Lakes, respectively, which is considerably less than the 3-5 kg/ha-yr limit for nitrogen deposition. Therefore, the proposed TSPP should not adversely contribute to changes in lake acidity that would otherwise be attributable to natural sources. As stated above, Jarbidge Wilderness Area was identified as an area particularly sensitive to acid deposition. Acid deposition calculations for the other wilderness areas of concern were also computed using the screening procedure. Results of the calculations are provided in Table 4-46. These calculations were based on the maximum modeled SO_2 and NO_2 concentrations in each wilderness area due to TSPP emissions with all eight units operating.

Potential increases in acid deposition resulting from the proposed TSPP in the other wildnerness areas are listed in Table 4-46. All of these areas, with the exception of Jarbidge Wilderness, are in Class II regions and are currently managed as such. For Class II areas the computed deposition rates can be compared to the LACs applied to Class I areas (see Table 2-10). Currently, there are no LACs set for Class II areas. The calculations were based on maximum modeled SO_2 and NO_2 concentration increases from TSPP emissions with all eight units in operation. The air quality modeling results provide conservative results since no deposition or chemical transformation of SO_2 or NO_2 were assumed during plume transport and all of the predicted SO_2 and NO_2 concentration in each area was assumed to be converted to its acidic species, respectively. For all of the areas listed in Table 4-46, except for Bluebell Wilderness Study Area and East Humboldt Wilderness Area, the sulfate deposition would be less than the Class I LAC for Jarbidge Wilderness Area of 5 kg/ha-yr. For Bluebell and East Humboldt, depositional sulfate was projected to be 6.62 and 5.68 kg/ha-yr. In terms of total sulfur deposition, all of the areas in Table 4-46 had projected sulfur deposition less than the USFS Class I Wilderness AQRV management guidelines of 5 kg/ha-yr. Projected total depositional nitrogen for all areas in Table 4-46, except East Humboldt Wilderness Area, were less than the Class I Wilderness AQRV management guidelines of 5 kg/ha-yr. The projected total depositional nitrogen in East Humboldt Wilderness Area was 5.97 kg/ha-yr. These Class I LACs may be more restrictive than would normally be applied to a Class II area.

Based on conservative air quality modeling methodologies and USFS screening procedures, the projected deposition rates for sulfate in Bluebell Wilderness Study Area and East Humboldt Wilderness Area would be greater than the LACs specified for the Jarbidge Wilderness Class I area. The projected total depositional nitrogen would be greater than the suggested LACs provided in the USFS Class I Wilderness management guidelines. If less conservative assumptions were used, the resulting computed deposition would likely be less than described above. The above projected deposition rates in Bluebell Wilderness Study Area and East Humboldt Wilderness Area (both Class II areas) would be considered significant impacts when the LAC criteria for Class I areas are applied.

In addition to evaluating the potential effects of the proposed TSPP emissions on acid depostion on the wilderness areas in the nearby region

Table 4-46. SUMMARY OF ANNUAL AVERAGE SO_2 AND NO_2 CONCENTRATIONS AND DEPOSITIONS RATES IN JARBIDGE AND OTHER WILDERNESS AREAS OF CONCERN

	Annual Average Concentration			TSPP			BACKGROUND			TOTAL DEPOSITION (TSSP+BACKGROUND)		
Location	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	PM ($\mu g/m^3$)	Sulfur Deposition (kg/ha-yr)	Sulfate Deposition (kg/ha-yr)	Nitrogen Deposition (kg/ha-yr)	Sulfur Deposition (kg/ha-yr)	Sulfate Deposition (kg/ha-yr)	Nitrogen Deposition (kg/ha-yr)	Sulfur Deposition (kg/ha-yr)	Sulfate Deposition (kg/ha-yr)	Nitrogen Deposition (kg/ha-yr)
Bluebell WSA	0.70	1.80	0.06	2.21	6.62	5.68	0.37	1.10	0.29	2.57	7.72	5.97
Goshute Peak WSA	0.40	1.10	0.04	1.26	3.78	3.47	0.37	1.10	0.29	1.63	4.88	3.76
South Pequop WSA	0.40	1.00	0.03	1.26	3.78	3.15	0.37	1.10	0.29	1.63	4.88	3.44
Badlands WSA	0.30	0.80	0.03	0.95	2.84	2.52	0.37	1.10	0.29	1.31	3.94	2.81
Ruff Hills WSA	0.20	0.50	0.02	0.63	1.89	1.58	0.37	1.10	0.29	1.00	2.99	1.87
E. Humboldt WA	0.60	1.40	0.05	1.89	5.68	4.42	0.37	1.10	0.29	2.26	6.78	4.71
Jarbidge WA[1]	0.30	0.80	0.03	0.95	2.84	2.52	0.60	1.80	0.47	1.55	4.64	2.99
Jarbidge Ext. WA	0.40	1.00	0.03	1.26	3.78	3.15	0.60	1.80	0.47	1.86	5.58	3.62
Ruby Mountains WSA	0.40	1.10	0.04	1.26	3.78	3.47	0.37	1.10	0.29	1.63	4.88	3.76

WSA = Wilderness Study Area
WA = Class I Wilderness Area
[1] = Class I Area

(within 100 km), acid deposition on Class I areas beyond 100 km were also evaluated. As stated earlier, some of these Class I (see Figure 2-2) areas are in the direction of the prevailing upper level winds, and therefore, emissions from the proposed TSPP could potentially be transported to these areas.

To evaluate acid deposition effects, air quality modeling using very conservative assumptions was performed. The EPA-approved ISC model was used in conjunction with meteorological data (100-meter level) collected at the proposed TSPP site. This model is not normally used to compute concentrations at such large distances from a source, but should yield a very conservative result when used at these distances. In addition, during plume transport no chemical transformation or deposition was assumed. Results of this modeling for acid deposition in Class I areas are shown in Table 4-47. Using the LACs developed by the Forest Service for sulfate deposition, and depositional sulfur and nitrogen as significance criteria, and the fact that the modeling methodology provided overestimates of actual SO_2 and NO_2 concentrations, none of the deposition rates predicted would be significant.

4.5.3.3 Lichens. Based on the assessment of acid deposition for Jarbidge Wilderness Area presented above, the LAC for lichens of 5 kg/ha-yr of total depositional sulfate, would not be exceeded. Therefore, the proposed TSPP project would not have a significant impact on flora.

4.5.4 Cumulative Impacts

Cumulative air quality impacts associated with the proposed TSPP project in combination with other air pollution sources were evaluated for significance. Minor sources located within approximately 100 kilometers of the proposed project site and proposed or permitted major sources located in Nevada and western Utah were included in the analysis. The primary criteria for evaluating a significant cumulative impact from the TSPP project were the EPA significance levels.

The term "cumulative impacts" refers to the concept that the various environmental effects of two or more projects, when considered together, may compound or increase environmental impacts beyond what would be expected if each project were considered separately. Cumulative impacts can include the combined effect of specific, defined projects/actions which are planned, projected, or otherwise reasonably foreseeable in the project study area. They can also include the cumulative changes in the environment that may take place from foreseeable population or economic growth, or regional changes in the environment, to which a proposed project/action may add incremental impacts.

4.5.4.1 Major Sources. The potential for reasonably foreseeable future projects/actions to occur in the time frame of the proposed TSPP project was investigated. Described below are how the relevant projects/actions were identified and investigated and the potential cumulative environmental impacts that may occur, if the proposed TSPP project and the other identified projects/actions proceed as planned.

Table 4-47. PREDICTED MAXIMUM INCREASE IN ANNUAL AVERAGE SO_2 AND NO_2 CONCENTRATIONS, AND SULFUR AND NITROGEN DEPOSITION IN REGIONAL CLASS I AREAS AND GREAT BASIN NATIONAL PARK FROM TSPP EMISSIONS

Receptors	Annual[a] SO_2 Conc. ($\mu g/m^3$)	Annual[a] NO_2 Conc. ($\mu g/m^3$)	Sulfur[b] Deposition (kg/ha/yr)	Sulfate[c] Deposition (kg/ha/yr)	Nitrogen[d] Deposition (kg/ha/yr)
IDAHO:					
Craters of the Moon National Monument	0.15	0.37	0.47	1.41	0.70
Sawtooth Wilderness	0.10	0.26	0.32	0.97	0.48
Hells Canyon Wilderness	0.05	0.13	0.16	0.48	0.24
UTAH:					
Capitol Reef National Park	0.06	0.15	0.19	0.58	0.29
Zion National Park	0.06	0.15	0.19	0.56	0.28
WYOMING:					
Bridger Wilderness	0.08	0.19	0.24	0.72	0.36
Grand Teton National Park	0.05	0.13	0.16	0.49	0.24
Teton Wilderness	0.05	0.12	0.15	0.44	0.22
Yellowstone National Park	0.07	0.17	0.21	0.63	0.32
NEVADA:					
Great Basin National Park[e]	0.08	0.19	0.24	0.73	0.37

[a] Concentration assumes no deposition or chemical conversion.

[b] Deposition values computed assuming all SO_2 converted to sulfur.

[c] Deposition values computed assuming all SO_2 converted to sulfate.

[d] Deposition values computed assuming all NO_2 converted to nitrogen.

[e] Great Basin National Park is a Class II area.

The identification of relevant projects/actions was conducted using a formal process to minimize ungrounded speculation (since it is not possible to accurately predict specific future decisions or developments). The process used here included four sequential steps, which are discussed below:

- Step 1--Define the time frame for the analysis.
- Step 2--Identify reasonably foreseeable future projects/actions which may occur within the defined time frame.
- Step 3--Consider the zones of influence of the environmental effects for each identified project/action.
- Step 4--Designate the projects/actions and their respective cumulative environmental impacts.

The following paragraphs describe how this four-step process was used to identify the projects/actions.

The proposed TSPP project is planned to begin construction in 1991, to be constructed in stages and be completed in 2008, and to operate for a period of approximately 35 years. The proposed TSPP project can be expected to have some environmental effects at any time during this period. Therefore, the time frame for the analysis of potential cumulative impacts was defined as extending from 1991 through 2043.

Step 2 consisted of reviewing the status of various projects, public agency programs, and other actions that presently exist, or are formally approved, or are actively involved in a formal public review process. It is necessary to establish such criteria to prevent the cumulative impact analysis from becoming so speculative that it would not serve the reviewers' purpose (nor would it comply with Federal requirements).

The following projects/actions were identified and judged to be relevant to this assessment of cumulative air quality impacts:

- White Pine Power Project. This 1500-MW coal-fired power plant project and associated transmission facilities was proposed to be built in Steptoe Valley, in White Pine County, Nevada (48 miles north of Ely). It was originally proposed by White Pine County, Sierra Pacific Power Company, and Nevada Power Company. The proposed project was evaluated in a BLM EIS (dated 1984) and obtained necessary air quality permits from state and Federal agencies. However, for a variety of economic and other reasons, the project has not been built and its PSD permit has expired. There have been recent indications that the White Pine Power Project may be revived in the foreseeable future. If that should occur, it would be necessary to review updated proposals and existing documentation to determine if changes to the proposed action and/or environmental setting have occurred. It would also be necessary to re-evaluate the air pollution control system in the context of current BACT requirements. It may also be necessary to apply for certain other environmental permits and approvals (including a PSD permit). These environmental studies and permitting actions would consider the TSPP project in their cumulative impact analyses. The White Pine Power Project does not actually meet the above-cited criteria (i.e., it is not presently permitted and is not under formal review for permitting actions). However, it is a large project that is well-known in the vicinity, and it does warrant consideration in this EIS. Because certain of the data that are presently available for its probable air pollutant emissions may not be applicable any longer, its air quality impacts could not be considered in a detailed, quantitative manner in this cumulative impact analysis.

- Harry Allen Station. This proposed 2240-MW (four 560-MW units) coal-fired power plant in southern Nevada was the subject of considerable environmental analysis and review in the late 1970s. In recent times there have been indications of renewed interest in that project as well. It does not fully meet the criteria for being a reasonably foreseeable future project/action, but it was included in the cumulative impact analysis because of its size.

- Moapa Power Project. This 100-MW natural-gas-fired cogeneration facility is proposed by the Moapa Power Associates. It is located on the Moapa Indian Reservation, approximately 40 miles northeast of Las Vegas, Nevada. Construction is anticipated to begin in July 1990. The BLM is currently evaluating whether to prepare an Environment Assessment or an EIS.

- New gold mining projects which are expected to be developed in the area north of Crittenden Reservoir. There is presently a high degree of activity on approximately 15 prospective sites located in a zone which extends from approximately 18 miles to 30 miles north of the TSPP site. The exploration activities are proceeding under permits from the BLM, and it is anticipated that one or more of the projects may develop into a successful gold mining operation. However, at present, no mine proposals have been submitted to the BLM, and it is not yet possible to accurately predict the character, the scale, or the timing of possible future gold mining operations. In order to assess cumulative impacts with gold mining projects in the area, a hypothetical mining project is assumed, similar to the one described and analyzed in the Mother Lode Environmental Assessment (BLM 1989c): A medium-sized gold mining project, utilizing approximately 100 construction workers and 75 operation workers. Water use is assumed to be approximately 400 ac-ft/yr at an average of 250 gpm. This gold mine is assumed to be located 18 to 30 miles north of the TSPP project site.

The following were considered but were not judged to be reasonably foreseeable future projects/actions, because they do not meet the above criteria:

- Barite mining activities in the Snake Mountains. It is recognized that there are significant deposits of barite which could be mined in the vicinity to the west of the TSPP project site. However, given the present and foreseeable future market conditions for barite (and the products it is manufactured into), it would be inappropriately speculative to predict either the scale or the timing of new construction, mine development, or new or resumed mining activities that might be proposed. If and when specific plans for such activities are formally proposed to the BLM and other public agencies for their review and/or approval, the cumulative environmental impacts of the mines and TSPP impacts can be evaluated.

The zones of influence of each project's air quality effects were considered in Step 3. This was done to determine the geographic areas where cumulative impacts might occur (i.e., within the areas where the zones might overlap). In this analysis, the zones of impact for air quality were considered for the proposed TSPP and the cumulative projects. Where the zones of influence were judged to be likely to overlap (if all projects proceed simultaneously), those areas were defined as having cumulative impacts. Where there would be no overlap of zones, there would be no cumulative impacts.

In Step 4, the above-described process was used to focus the attention of this technical report section on potential cumulative air quality impacts for the following projects/actions:

- The proposed TSPP project itself

- The two large-scale coal-fired power plants that were previously proposed near Ely and near Las Vegas (White Pine Power Project and Harry Allen Station, respectively)

- A hypothetical, medium-sized gold mining project

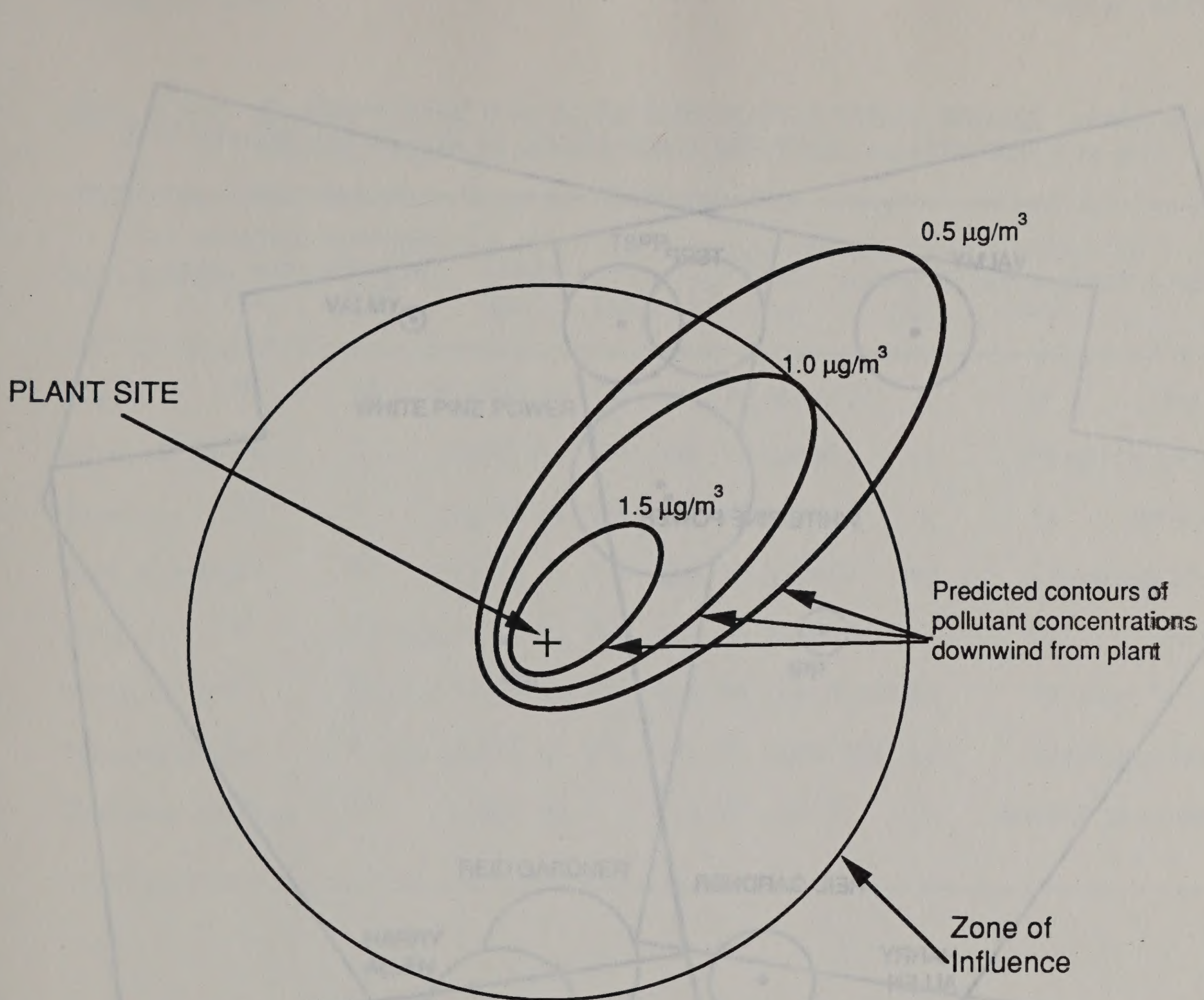
Project-related cumulative air quality impacts associated with construction and operation of the proposed TSPP project are discussed below.

Air quality modeling of particulate emissions from the TSPP project's plant stacks showed that the maximum annual concentration increase would be less than the EPA significance level of 1 $\mu g/m^3$ (which applies to annual average conditions). Therefore, TSPP's stack-related particulate matter impacts would be insignificant when combined with particulate matter from other sources. Although there would be greater quantities of particulate matter emitted from fugitive sources at TSPP (i.e., greater than the stack emissions), concentration increases from those fugitive sources would be localized in nature, primarily because of the low release heights. For this reason, their impacts would occur in zones of influence that would be too small to overlap with the impacts from other sources.

The cumulative SO_2 and NO_2 impacts of the proposed TSPP and other proposed or permitted major sources located in Nevada and western Utah were assessed as follows. Air quality impacts from the major sources were estimated using the EPA-approved ISC dispersion model. Conservative meterological assumptions were used. For wind, joint frequency distributions were used, employing data from the airports nearest to the respective sources. For each major source, the emissions and stack parameters given in Table 3-13 were modeled to determine their respective zones of influence. These zones were defined as circular areas whose radii are determined by the maximum extent of the 1-$\mu g/m^3$ modeled concentration contour for SO_2 or NO_2 (see Figure 4-9). Concentrations less than this value would be below the EPA significance levels and are considered (in this cumulative impact assessment) as not contributing to violations of air quality increments or standards.

Figures 4-10 and 4-11 and Tables 4-48 and 4-49 show the modeled zones of influence for the proposed TSPP and each of the major sources assessed for their annual effects. As shown, the TSPP's zone does not overlap with any of the other zones; therefore, on an annual average basis, no significant cumulative impacts should result between the proposed TSPP and these proposed or permitted major sources. Similar modeling was performed to assess potential cumulative impacts on a 24-hour averaging basis. Attention was focused on TSPP and the two nearest plants (i.e., Valmy and White Pine Power Project). There is no 24-hour EPA-defined significance level for NO_2, so the assessment considered only SO_2. The proposed White Pine Power Project has low SO_2 emissions and very tall stacks, so there was no overlap of Zones of Influence. However, the Zones of Influence for SO_2 from Valmy and TSPP would be sizable and were found to come close to overlapping, as shown on Figure 4-12 and in Table 4-50.

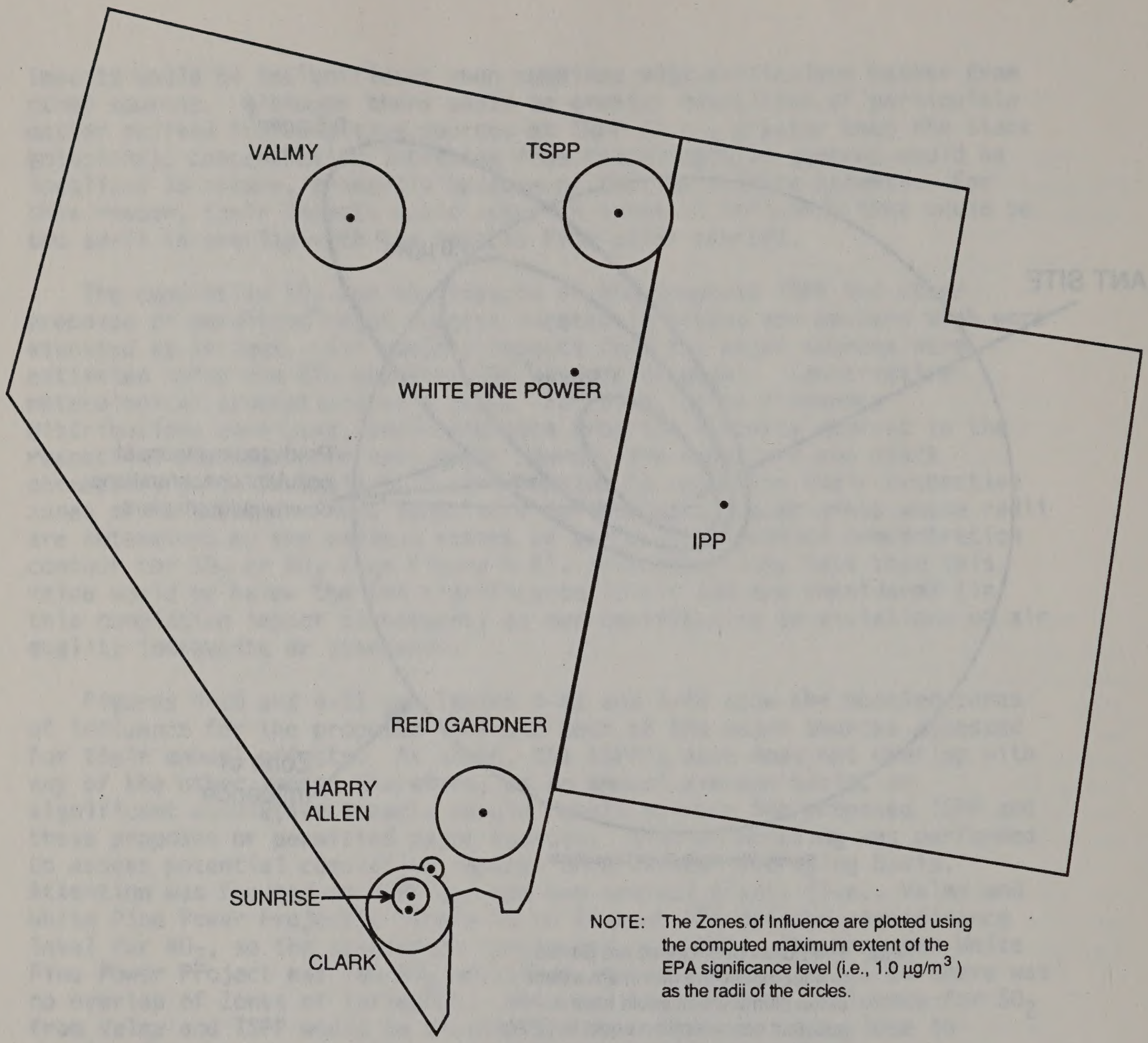
Although TSPP emissions would not have a significant cumulative impact when evaluated with other regional sources, TSPP would contribute to a general decrease in the air quality of the region. That is, concentration levels for the pollutants emitted would increase in the project region, but these increases would be within allowable levels. In addition, TSPP would cause concentration increases in pollutants that affect the visibility of the project region. However, as discussed in Section 4.5.3.1 the projected effects from TSPP would be below allowable levels.


0.5 µg/m³
1.0 µg/m³
PLANT SITE
1.5 µg/m³
Predicted contours of pollutant concentrations downwind from plant
Zone of Influence

Source: Woodward-Clyde Consultants

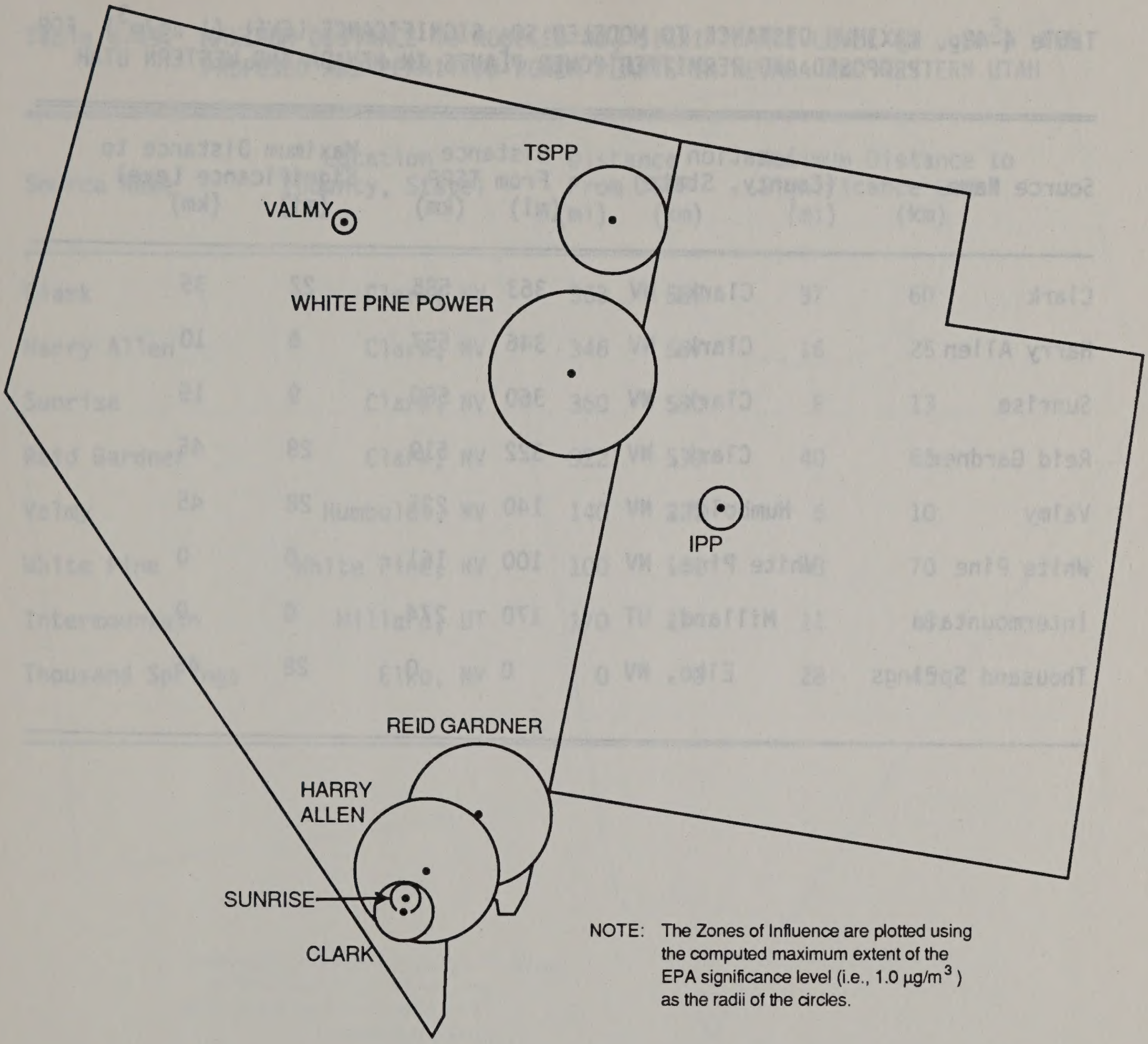
Note: The Zones of Influence are plotted to encompass the maximum extent of the plume which could have a pollutant concentration equal to EPA's significance level. (The annual average significance level of 1.0 $\mu g/m^3$ is depicted above as an example).

Figure 4-9. GRAPHICAL EXPLANATION OF ZONES OF INFLUENCE FOR AIR POLLUTANTS



NOTE: The Zones of Influence are plotted using the computed maximum extent of the EPA significance level (i.e., 1.0 µg/m^3) as the radii of the circles.

FIGURE 4-10. ZONES OF INFLUENCE FOR SO_2 EFFECTS - ANNUAL AVERAGE CONDITIONS



NOTE: The Zones of Influence are plotted using the computed maximum extent of the EPA significance level (i.e., 1.0 μg/m^3) as the radii of the circles.

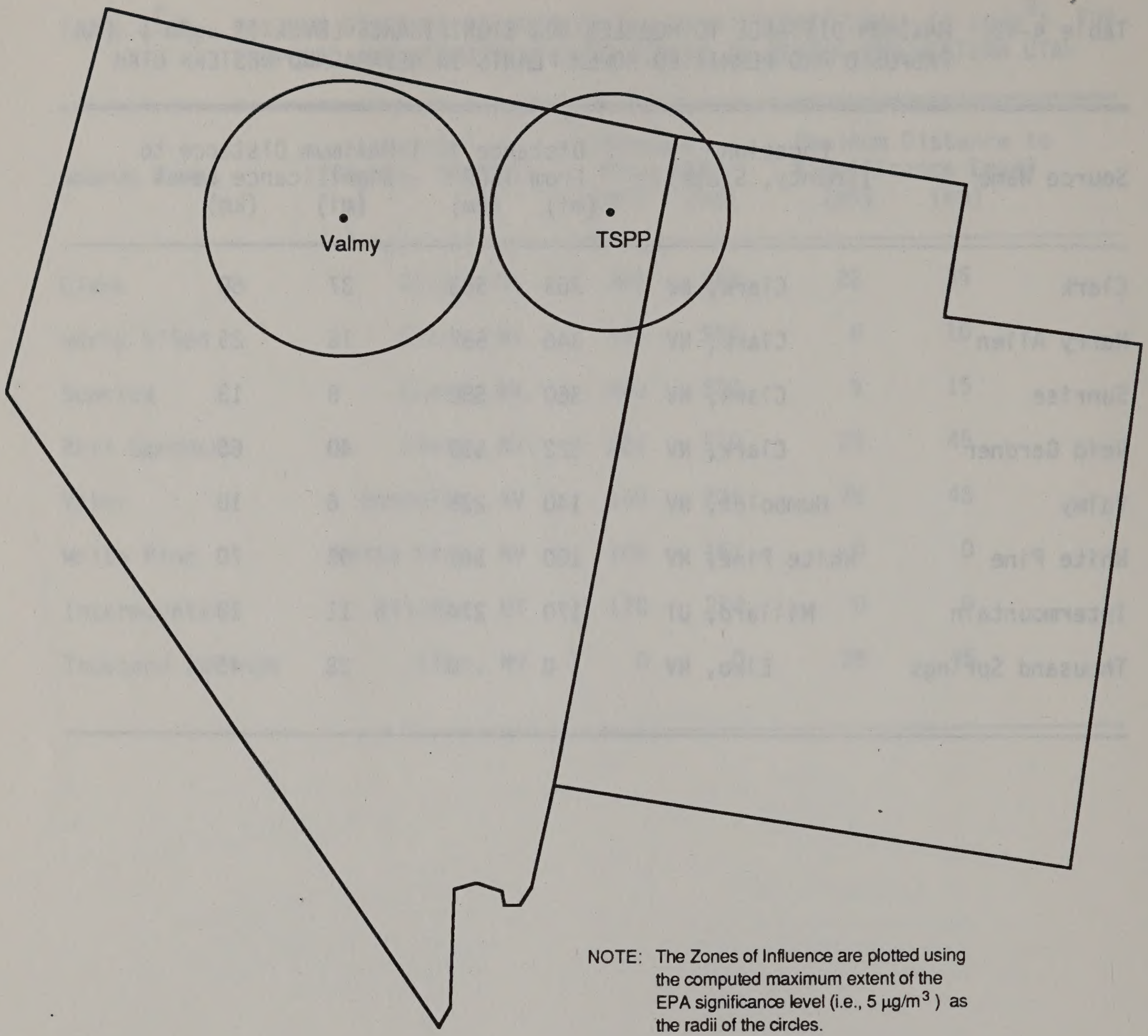
FIGURE 4-11. ZONES OF INFLUENCE FOR NO_2 EFFECTS - ANNUAL AVERAGE CONDITIONS

Table 4-48. MAXIMUM DISTANCE TO MODELED SO_2 SIGNIFICANCE LEVEL (1 $\mu g/m^3$) FOR PROPOSED AND PERMITTED POWER PLANTS IN NEVADA AND WESTERN UTAH

Source Name	Location (County, State)	Distance From TSPP (mi)	Distance From TSPP (km)	Maximum Distance to Significance Level (mi)	Maximum Distance to Significance Level (km)
Clark	Clark, NV	363	585	22	35
Harry Allen	Clark, NV	346	557	6	10
Sunrise	Clark, NV	360	580	9	15
Reid Gardner	Clark, NV	322	519	28	45
Valmy	Humboldt, NV	140	225	28	45
White Pine	White Pine, NV	100	161	0	0
Intermountain	Millard, UT	170	274	0	0
Thousand Springs	Elko, NV	0	0	28	45

Table 4-49. MAXIMUM DISTANCE TO MODELED NO$_2$ SIGNIFICANCE LEVEL (1 $\mu g/m^3$) FOR PROPOSED AND PERMITTED POWER PLANTS IN NEVADA AND WESTERN UTAH

Source Name	Location (County, State)	Distance From TSPP (mi)	Distance From TSPP (km)	Maximum Distance to Significance Level (mi)	Maximum Distance to Significance Level (km)
Clark	Clark, NV	363	585	37	60
Harry Allen	Clark, NV	346	557	16	25
Sunrise	Clark, NV	360	580	8	13
Reid Gardner	Clark, NV	322	519	40	65
Valmy	Humboldt, NV	140	225	6	10
White Pine	White Pine, NV	100	161	43	70
Intermountain	Millard, UT	170	274	11	18
Thousand Springs	Elko, NV	0	0	28	45



NOTE: The Zones of Influence are plotted using the computed maximum extent of the EPA significance level (i.e., 5 $\mu g/m^3$) as the radii of the circles.

FIGURE 4-12. ZONES OF INFLUENCE FOR SO_2 EFFECTS - 24-hr. AVERAGE CONDITIONS

Table 4-50. MAXIMUM DISTANCE TO MODELED 24-HOUR SIGNIFICANCE LEVEL (5 $\mu g/m^3$) FOR VALMY POWER PLANT AND THE PROPOSED TSPP

Source Name	Location (County, State)	Distance From TSPP (mi)	(km)	Maximum Distance to Significance Level (mi)	(km)
Valmy	Humboldt, NV	140	225	62	100
Thousand Springs	Elko, NV	0	0	59	95

4.5.4.2 Minor Sources

To assess the cumulative SO_2 and NO_2 impacts of the proposed TSPP and other minor sources located within 100 kilometers of the TSPP (see Section 3.5.2 for source emission inventory), maximum impacts for minor sources located in Elko and Wendover, Nevada were calculated. The TSPP's contribution at the point(s) of maximum impact was then computed and the impacts summed to determine the overall cumulative impact. The ISC Model was used for this assessment. A flat terrain receptor grid with kilometer spacing between receptors was used. Meteorological input to ISC consisted of using F stability, a 2.5 meter per second windspeed, an ambient temperature of 293 degrees Kelvin and a 600 meter mixing height. These procedures are generally considered to result in conservative (overestimation) impact assessments. Additionally, because of the spacial distribution of the sources and TSPP, separate modeling runs were made based on geographic groupings of sources, with the cumulative impact being determined by combining the impacts at the receptor(s) of concern. This approach results in a conservative estimate, as it essentially assumes that the wind flow (wind direction) may be from two directions simultaneously. That is, the wind direction resulting in the maximum impact from the regional source grouping may be different than the wind direction necessary for emission from the TSPP to impact the receptor where that maximum occurs.

The maximum modeled cumulative annual average SO_2 and NO_2 impacts for the TSPP and sources located in the Elko area were 65.5 $\mu g/m^3$ and 25.5 $\mu g/m^3$, respectively. Both values are below their respective NAAQS of 80 $\mu g/m^3$ for SO_2 and 100 $\mu g/m^3$ for NO_2. TSPP's contributions to these concentrations was 0.1 $\mu g/m^3$ for SO_2 and 0.3 $\mu g/m^3$ for NO_2, well below the 1-$\mu g/m^3$ significance limit. The maximum cumulative 24-hour SO_2 concentration was 262.1 $\mu g/m^3$ compared to the 24-hour standard of 365 $\mu g/m^3$. TSPP's contribution was 0.6 $\mu g/m^3$.

The maximum modeled cumulative annual average of SO_2 and NO_2 impacts for the TSPP and sources located in the Wendover area were 54.8 $\mu g/m^3$ and 30.1 $\mu g/m^3$, respectively. Again, both values are below their respective NAAQS. TSPP's contributions to these concentrations was 0.1 $\mu g/m^3$ for SO_2 and 0.3 $\mu g/m^3$ for NO_2, well below the 1 $\mu g/m^3$ significance limit. The maximum cumulative 24-hour SO_2 concentration was 219.1 $\mu g/m^3$ compared to the 24-hour standard of 365 $\mu g/m^3$. TSPP's contribution was 0.3 $\mu g/m^3$.

4.5.5 Secondary Impacts

It is expected that the towns of Elko and Wells would experience increases in population and vehicular activity due to construction and operation of the proposed TSPP. The two communities would experience a project population increase of about 2038, at peak workforce (year 2000). In turn, this would produce the need for 827 homes, of which it is estimated that 537 new homes would be built.

The air quality impacts of a population increase in the Elko and Wells area would be primarily due to initial home development, residential space heating, and vehicular exhaust. To calculate potential dust emissions from new home construction, fugitive particulate matter emission factors from EPA's AP-42 document (EPA 1985) were used. For the analysis of residential space heating, the assumed breakdown of energy sources was 35-percent electric, 30-percent wood-burning, and 35-percent propane fuel, and again EPA AP-42 emission factors were used to calculate potential emissions. Table 4-51 gives the estimated emissions for new home construction and residential space heating.

Maximum ambient air pollutant concentrations associated with the above secondary growth emissions were estimated with a ventilated box model. The equation for a box model is:

$$\chi = Q/uA$$

Where: χ = ground-level pollutant concentration ($\mu g/m^3$)
Q = pollutant emission rate ($\mu g/s$)
u = mean windspeed (m/s)
A = cross sectional area of wind over the city (m^2)

The wind cross-sectional area, A, was calculated by multiplying an assumed cross-wind width of 1 km (1000 m) by a conservative atmospheric mixing height of 1000 m. The mean annual windspeed as measured in Elko and Wells is 2.6 m/s (6 mph). Annual concentrations were conservatively estimated using a 1.0 m/s windspeed. Table 4-51 shows the resulting predicted contributions to existing ambient air concentrations. These estimated emissions and ambient air impacts are insignificant in comparison with emissions from the proposed TSPP (see Table 4-4) and EPA significance levels for air quality impacts (see Table 2-4).

In order to estimate air quality impacts from vehicular exhaust, the projections of future traffic were combined with estimates of project-related vehicle volumes on roadways that would be most affected (Section 5.13.1.2 of the EIS). Maximum traffic volumes are predicted for the year 2000 due to the overlap between construction and operation work forces. Worst-case CO and NO_2 emissions were modeled for a 1-hour peak traffic period using the no construction-worker camp alternative, with the location of maximum impact being the intersection of Highway 93 and 6th Street in Wells through which a major portion of the traffic traveling to the plant would pass. This estimate is conservative because workers residing in Twin Falls or Jackpot (with the proposed access and Brush Creek Alternative) and Wendover (with the Moor Summit Alternative) would not pass through this intersection. Vehicular emissions were calculated from the traffic projections using the EMFAC7PC computer program (California Air Resources Board 1987). The information needed for the EMFAC7PC model includes vehicle mix, speed of travel, percentage of mileage in cold-start, hot-start, and hot stabilized modes, year of analysis, and ambient temperature. Table 4-52 gives the values used for the Wells Intersection analysis. Ambient air pollutant concentrations were computed from the vehicular emissions using the CALINE4 dispersion model (California

Table 4-51. PROJECTED AMBIENT AIR IMPACTS FROM CONSTRUCTION AND RESIDENTIAL HEATING ASSOCIATED WITH SECONDARY GROWTH

Pollutant	Emission Rates (Tons/Year) Space Heating: Propane	Wood	Housing Construction	Total	Predicted Annual Concentration[a] ($\mu g/m^3$)
Elko					
Particulates	0.1	28.1	259	287.2	0.83
Sulfur Dioxide	--	0.3		0.3	0.00
Carbon Monoxide	0.38	55.4		55.8	0.16
Oxides of Nitrogen	1.8	1.4		3.2	0.01
Wells					
Particulates	--	7.6	84.6	82.2	0.24
Sulfur Dioxide	--	--		--	--
Carbon Monoxide	0.1	15.2		15.3	0.04
Oxides of Nitrogen	0.5	0.4		0.9	0.00

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[a] Contribution from construction and residential heating (i.e., above existing background concentrations).

Table 4-52. PARAMETERS USED IN EMFAC7PC VEHICULAR EMISSION CALCULATIONS AT WELLS INTERSECTION

Parameter	Data
Year of Analysis Vehicle Speed	2000
Vehicle Speed	5 mph
Vehicle Mix[a]	
Light Duty Vehicle	48.1%
Light Duty Truck	22.0%
Medium Duty Truck	6.0%
Heavy Duty Gas Truck	3.0%
Heavy Duty Diesel Truck	20.3%
Motorcycle	0.2%
Percentage Hot/Cold Start	25%
Temperature	$0^{O}C$

[a] Provided by NDOT (1987).

Department of Transportation 1984). Inputs into the CALINE4 model are given in Table 4-53. Table 4-54 depicts the calculated worst-case vehicular impacts from this analysis, and shows them to be well within applicable ambient air quality standards.

4.6 GLOBAL WARMING (GREENHOUSE EFFECT)

Section 3.6 discussed the relationship between atmospheric releases of heat-trappping gases and possible increases in future global temperature, i.e., the so-called "greenhouse effect." These gases include carbon dioxide (CO_2), methane, chlorofluorocarbons, nitrous oxide, tropospheric (lower atmosphere) ozone, and several other trace gases (EPRI 1988). Greenhouse gas sources (Marland and Rotty 1985; EPRI 1988) can be anthropogenic, natural, or both (see Table 4-55).

Of these gases, CO_2 is thought to have the largest contribution (49 percent) to global warming, and comprises by far the most significant portion of the proposed TSPP's gaseous emissions. Estimates of the contribution from the U.S. to total global CO_2 emissions due to fossil fuel combustion range from 20 to over 25 percent. Of the total U.S. CO_2 emissions, 30 to 35 percent comes from fossil-fuel-fired electric power plants, about 20 to 30 percent from transportation, 20 to 25 percent from industrial/commercial sources, and 10 to 15 percent from the residential sector (EPRI 1988; OTA 1988; Machado and Piltz 1988).

The proposed TSPP project is estimated to emit about 2.1 million tons/year of CO_2 from each 250-MW unit, or about 16.8 million tons/year of CO_2 (4.3 million metric tons per year of carbon) when all eight generating units become operational. Based on current estimated global and U.S. emissions of CO_2 from fossil fuel combustion, the projected TSPP CO_2 emissions, with all eight generating units in operation, would represent an increase of 0.02 to 0.08 percent of global emissions and about 0.3 percent of U.S. emissions. Owing to the large uncertainties in predicting future local and global concentrations of CO_2 and their effect on climate, ascertaining the effect of an increase in global CO_2 emissions in the range of 0.02 to 0.08 percent is not possible with today's technology (models).

There are no plans to control CO_2 emissions from fossil fuel combustion. The most feasible CO_2 emission control technology is CO_2 scrubbing. This technology has not been demonstrated at a scale comparable to a power plant, and it would require about 6 percent of the plant's generation capacity to operate. In addition, disposal of the collected CO_2 would pose considerable problems (EPA 1988e; OTA 1988). If CO_2 removal technologies prove feasible in the future, they could be required for the project's generation units as each unit is proposed for construction and operation.

There are no current proposed new modifications to the Clean Air Act or global climate change law(s) being considered by congress that would affect CO_2 emissions from this project. One could assume, however, that

Table 4-53. PARAMETERS USED FOR CALINE4 MODELING AT WELLS INTERSECTION

Parameter	Data
Vehicle Emission Factors from EMFAC7PC:	
CO	69.8 g/veh-mi[a]
NO_2	5.9 g/veh-mi
Background Concentrations:	
CO	1.0 ppm
Ozone	0.06 ppm
NO	0.005 ppm
NO_2	0.005 ppm
Temperature	0°C
Mixing Height	1000 meters
Wind Speed	1.0 m/sec
Stability	G
Vehicle Speed	5 mph
Receptor Distance from Road	5-27 m

[a] Grams per vehicle-mile.

Table 4-54. WORST-CASE AMBIENT CONCENTRATIONS AT WELLS INTERSECTION FROM MOBILE SOURCES RELATED TO SECONDARY GROWTH

Pollutant	Averaging Time	Background (μg/m^3)	Impact (μg/m^3)	Total (μg/m^3)	National Standard (μg/m^3)	Nevada Standard (μg/m^3)
Carbon Monoxide	1-Hour	1,142[a]	1,600	2,742	40,000	40,000
Carbon Monoxide	8-Hour	1,142[a]	1,280	2,422	10,000	6,670[b]
Oxides of Nitrogen	Annual	1.9	7.5	9.4	100	100

[a] Source: Johnson (1989)

[b] Standard applies at elevations greater than 5000 feet MSL.

Table 4-55. SOURCES OF GREENHOUSE GASES

Gas	Sources
• Carbon dioxide	fossil fuel combustion other combustion sources with carbon decomposition of vegetation sour gas processing (natural gas) portland cement operations
• Methane	anaerobic decomposition of organics in rice paddies termites landfills digestive tract of livestock
• Nitrous oxide	agricultural fertilizer fossil fuel combustion volcanos lightning oceans, lakes, soils industrial manufacturing
• Chlorofluorocarbons	refrigerant solvent aerosol propellant industrial manufacturing
• Ozone	lightning sunlight on NO_x and hydrocarbon ultraviolet radiation on oxygen

reasonable facsimiles of tabled laws will be re-introduced during future congressional sessions. Although President Bush's proposed modifications to the Clean Air Act did not address CO_2 emission limitations, there were other proposed laws that did seek to limit CO_2 emissions. The 1989 congress considered laws such as S324, which would have established a national goal of reducing CO_2 emissions by 20 percent by the year 2000; S2663, which would reduce CO_2 emissions by 50 percent by the year 2040; and S2666, which recommended switching to low CO_2-producing technologies. The implementation of these to-be-proposed laws is unclear at the present time, and therefore it is unknown if TSPP would be affected. The phased nature of TSPP would allow maximum flexibility in addressing future regulatory changes, since each generation unit would be subject to the regulatory requirements in place at the time the units are proposed for construction and operation.

Reduction or removal of CO_2 is feasible at a larger, global scale. Increasing carbon fixation can be achieved through methods ranging from fertilizing ocean plankton or freshwater algae, to planting large expanses of new forest. Conservation activities aimed at halting deforestation and forest degradation can also provide some degree of protection for existing forests, thus preventing the release of already fixed, sequestered carbon to the atmosphere. Increasing agricultural activity and productivity, and recuding the burning of agricultural fields can promote CO_2 fixation and avoid its release.

5.0
SUGGESTED MITIGATION

The purpose of this section is to describe suggested measures for the mitigation of potentially significant air quality impacts from construction and operation of the proposed project.

5.1 CONSTRUCTION IMPACTS

As discussed in Section 4.1, impacts due to dust generated by excavation and construction activities would be localized and of a temporary nature, and would not have a significant impact on long-term local or regional air quality. There could be, however, significant short-term ambient concentrations in the vicinity of construction activities. It is recommended that dust control practices be employed to minimize these potential short-term impacts. Such practices include, but are not necessarily limited to, general watering in active excavation and grading areas, use of watering or chemical stabilizers on completed cuts and fills and on temporary construction roads, and revegetation of disturbed areas.

5.2 OPERATIONAL IMPACTS

As part of the air quality permitting process (i.e., PSD permitting) that will follow the NEPA review, specific requirements for meteorological, air quality, and related environmental monitoring will be stipulated to assure compliance with the air quality permit conditions. Table 5-1 shows potential meteorological and air quality monitoring for TSPP, based on impacts associated with TSPP, and requirements stipulated by air quality regulatory agencies for other power plants.

The following mitigation measures are recommended to reduce project-related air quality impacts:

- Minimize exhaust emissions from private vehicles of construction and operation workers by bussing workers to and from the project site.
- It is recognized that TSPP will be a major source of sulfur dioxide, nitrogen oxide, and to a lesser extent, other air contaminants. Concentrations of air pollutants are projected to exceed the short-term (3- and 24-hour average) PSD increments. Due to the likelihood of actual transport, these exceedances

Table 5-1. POTENTIAL METEOROLOGICAL AND AIR QUALITY MONITORING FOR THE PROPOSED TSPP

Concern	Parameters To Be Monitored	Location of Monitoring
Compliance with Federal and State air quality requirements	Meteorology and criteria pollutants	Location of predicted maximum concentration
New source performance standards	Sulfur dioxide, nitrogen oxides, and opacity	Stack
Air Quality Related Values (AQRVs)	Visibility (fine particulates and visual range), acid deposition (pH and chemical speciation of rainfall), and indicator lichens (metals and sulfur)	Wilderness Areas*

* Monitoring of AQRVs is already being conducted at Jarbidge Wilderness Area. In general, AQRV monitoring is the responsibility of the Federal Land Manager.

should be viewed with skepticism (see Section 5.1). It is apparent, however, that all eight units of the proposed TSPP, if constructed as planned, may have the potential for adverse impacts to regional air quality.

To ensure that these potential impacts are either not realized or are mitigated through adding more efficient air pollution control technology, an air resources coordination group should be formed. This group should consist of representatives from the Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, Nevada Division of Environmental Protection, National Park Service, and Thousand Springs Generating Company. Their primary functions will be to provide technical information to the Nevada Division of Environmental Protection as it makes decisions concerning best available control technology on each of the eight generating units as they are individually permitted.

This information would primarily be gathered through a regional program which would address the following:

- Visibility, deposition, and particulate matter (less than 10 microns) monitoring programs in areas such as the Jarbidge Wilderness, East Humboldt Wilderness, Badlands Wilderness Study Area, Bluebell Wilderness Study Area, and others. Particular focus should take into account potential impacts to air quality related values in Class I areas.

- The U.S. Forest Service should be assisted in their air quality related values monitoring in Jarbidge Wilderness, as appropriate.

- Comparison of the above-described monitoring data with information gathered at existing National Atmospheric Deposition Program/National Treads Network, National Dry Deposition Network, and Interagency Monitoring of Protected Visual Environments monitoring sites on a continuous basis and to allow the Nevada Division of Environmental Protection to decide on control technologies for units as prior to construction or whether air pollution impacts had reached a level where no more units could be built.

- To date, the applicant has not applied for their Prevention of Significant Deterioration Permit. Therefore, the State of Nevada Department of Conservation and Natural Resources, Division of Environmental Protection has not made a determination as to the best available control technology nor the emission limits that would be appropriate and required for this proposed facility to be in compliance with Federal and state PSD regulations. Therefore, the Bureau of Land Management could consummate the land exchange contingent upon Thousand

Springs Generating Company meeting Nevada air quality permit conditions, PSD requirements, and providing continuous emissions monitoring during the operation of each unit to ensure the project is in compliance with all appropriate regulations.

6.0
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7.0
GLOSSARY

AAQS (Ambient Air Quality Standard):

A level of ambient air quality established by Federal or State agencies which is to be achieved and maintained; primary standards are those judged necessary, with an adequate margin of safety, to protect the public health; secondary standards are those judged necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

(1) long-term standard - typically, as an annual geometric or arithmetic mean concentration limit.

(2) short-term standard - typically, a 3- or 24-hour average concentration limit.

(3) primary standard - a concentration limit for each of the 6 criteria pollutants sufficient to protect the public health.

(4) secondary standard - a limit for a given pollutant that, according to the Clean Air Act, is to be set by the EPA at a level stringent enough to protect the public welfare.

Acid Deposition:

(Atmospheric Deposition): The wet and dry transfer of pollution from the atmosphere to the surface by any form of precipitation, gravitation, impaction, absorption, or adsorption.

Adverse Impact:

So unfavorable an effect as to cause harmful interference with the structure or function of a person, place, ecosystem or object. Any effect directly or indirectly caused by air pollution that exceeds identified limits of acceptable change.

Aerosol:

Finely divided particles of solid or liquid matter that can remain suspended in the atmosphere because of their small size. Particles under 1 micron diameter are generally called aerosols.

Air:

A mixture of gasses containing about 78 percent nitrogen; 21 percent oxygen; less than 1 percent carbon dioxide, argon, and other reactive and inert gases; and varying amounts of water vapor.

Air Mass:

A widespread body of air with chemical and physical properties that are approximately well defined.

Air Pollution (Pollutant):

Dust, fumes, mist, smoke, other particulate matter, vapor, gas, odorous substances, or a combination thereof, present in the outdoor (ambient) air in sufficient quantities and of such characteristics and duration as to be, or likely to be, injurious to human health or welfare, animals or plant life, or property, or as to interfere with the enjoyment of life or property.

Air Pollution Generating Activities:

Human-caused or allowed activities having the potential to create air pollution. Examples are manufacturing plants, fossil-fuel-fired steam boilers, prescribed fires, rock crushing, and road construction.

Air Pollution Potential:

The dispersive capability of the local atmosphere under given meteorological conditions. If the product of mixing height and wind speed is large, pollution potential is low. Conversely, if the product is small, pollution potential is high.

Air Quality Control Regions (AQCR):

The basic geographical units which must achieve and maintain air quality standards. Designated by the 1970 Amendments of the Clean Air Act, the boundaries are based on considerations of climate, meteorology, topography, urbanization, and other factors affecting air quality conditions.

Air Quality Maintenance Area (AQMA):

An area designated by the State and approved by EPA (county urbanized area, metropolitan statistical area, etc.) which, due to current air quality and/or project growth rates, may have the potential for exceeding any National Ambient Air Quality Standard (NAAQS) within the subsequent 10-year period.

Air Quality Model:

A qualitative, usually objective, technique for relating air pollutant emissions to likely downwind air quality. Typically, air quality models contain a plume rise algorithm, transport and diffusion module and a depletion term.

Air Quality Related Value (AQRV):

The Forest Service identified additional AQRVs are: visibility, odor, flora, fauna, soil, water, climate, geological features, and cultural resources. AQRVs are usually only considered in the context of PSD Class I area protection under the CAA. A subset of "Air Resource Values".

Airshed:

A term denoting a geographical area, the whole of which, because of topography, meteorology, and climate, shares the same air mass.

Allowable Emission Rate:

The emission rate of a source calculated using the maximum rated operating capacity of the source (unless the source is subject to federally enforceable limits which restrict the operating rate and the most stringent of the following: (a) the applicable standards set forth in 40 CFR Part 60 or 61; (b) any applicable State Implementation Plan (SIP) emissions limitation including those with a future compliance date; or (c) the emissions rate specified as a federally enforceable permit condition, including those with a future compliance date.

Ambient Air:

That air encompassing or surrounding a particular region; in particular, that portion of the atmosphere, external to buildings, to which the general public has access.

Ambient Air Pollution Concentrations:

Existing levels of contaminants in the local or regional air, usually pertaining to concentrations of particulate matter, sulfur dioxide, nitrogen oxides, ozone, and trace elements.

Ambient Air Pollution Isomap:

A graphic portrayal containing isopleths of the ambient concentrations of a specific pollutant throughout various areas of a mapped region.

Ambient Air Quality:

The mean concentration of a specific pollutant and over a specific averaging time period within a given geographical area.

AQRV Survey:

A detailed description of the basic physical characteristics of an area under study. The characteristics include climate, topography, geology, soils, vegetation, water, animals, fire, limiting physical factors, and human developments.

Area Source:

Any accumulation of small air pollutant sources. Also a homogeneous nonpoint source of air pollution such as a good storage pile.

Atmospheric Discoloration:

A change in the color of the sky, distant mountains, clouds, or other objects, caused by air pollution. Usually defined as a yellow or brown haze caused by absorption of blue light by nitrogen dioxide (NO_2).

Atmospheric Dispersion Potential:

The ability of the atmosphere over any defined area to diffuse or disperse air pollutants which are introduced into the atmosphere within the defined area from point, line or area emission sources.

Atmospheric Stability:

A measure of the vertical density gradient of the air as expressed through the vertical temperature profile. A measure of the ability of the atmosphere to diffuse air pollutants. Stable atmospheric conditions occur when temperature increases with height (temperature inversion) or when the temperature decreases with height at a smaller rate than the dry adiabatic lapse rate (1°C/100 meters). Vertical mixing is restricted under stable atmospheric conditions. Unstable conditions occur when the temperature decreases with height at a greater rate than the dry adiabatic lapse rate. Vertical mixing is enhanced by atmospheric instability. Neutral conditions occur when the temperature change with height is approximately the same as the dry adiabatic lapse rate. Mixing is neither enhanced or restricted in neutral conditions.

Attainment Area:

A geographical area in which the quality of the air is better than ambient air quality standards. PSD requirements apply to these areas.

Averaging Time:

The specified time over which pollutant, meteorological or other measurements are averaged. In most air quality applications, the duration ranges from one hour to one year.

Background Concentrations:

The ambient air concentration of an air pollutant due to natural or unaccounted for anthropogenic sources.

BACT (Best Available Control Technology):

An emission limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the EPA Administrator or his designee, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for each source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment of innovative fuel combustion techniques for control of such pollutant. In no event shall application of BACT technology result in emissions of any pollutant which would exceed the emission allowed by any applicable standards under 40 CFR Parts 60 and 61.

Baseline Concentration:

(1) That ambient concentration level which existed in the baseline area as of the baseline date, minus any contribution from major stationary sources and major modifications on which construction commenced on or after January 6, 1975. A baseline concentration is determined for each pollutant for which a baseline date is established and shall include (a) the actual emissions representative of sources in existence on the applicable baseline date, except as provided below; (b) the allowable emissions of major stationary sources which commenced construction before January 6, 1975, but were not in operation by the applicable baseline date.

(2) The following will not be included in the baseline concentrations and will affect the applicable maximum allowable increase: (a) Actual emissions from any major stationary source on which construction commenced after January 6, 1975; and (b) actual emission increases and decreases at any stationary source occurring after the baseline date. (Definition applies only to PSD permitting activities.)

Baseline Condition:

The status of a resource value at the time it was first measured or at some previous time if the status can be determined in some other way.

Baseline Date:

The date after August 7, 1975 on which the first complete PSD permit application was received by permit granting authority. A baseline date is established for each pollutant having an increment.

Box Model:

A technique for estimating transport and diffusion by assuming instantaneous and homogeneous diffusion within a specified atmospheric volume. The simple box model may be modified in many ways.

CAA (Clean Air Act):

(42 USC 1857 et seq., 7401 et seq.) An act for air pollution prevention and control to (1) protect and enhance public health and welfare and the productive capacity of its population; (2) initiate and accelerate a national research and development program to achieve the prevention and control of air pollution; and (3) provide technical and financial assistance to state and local governments in connection with the development and operation of regional air pollution control programs.

CFR:

Code of Federal Regulations.

Class I Area (PSD):

Geographic area designated for the most stringent degree of protection from future degradation of air quality. The Clean Air Act designates as mandatory Class I Areas each national park over 6000 acres and each national wilderness over 5000 acres that existed as of the date of enactment (August 7, 1977). Wilderness and additions to Wildernesses designated by law after this date are not Class I Areas unless they have been redesignated as such. To date, none have.

Class II Area (PSD):

Geographic area having air quality exceeding the National Ambient Air Quality Standards, which is unclassified, which is designated for a moderate degree of protection from future air quality degradation. Moderate increases in new pollution may be permitted in a Class II Area.

Class III Area (PSD):

Geographic area cleaner than National Ambient Air Quality Standards which is designated for a lesser degree of protection from future air quality degradation than afforded by Class I or II Areas. Significant increases in new pollution may be permitted in a Class III Area. No Class III Areas were specified at the time of enactment, although States are empowered to do so.

Clean Air Standards:

Any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted pursuant to the Clean Air Act or to Executive Order 11738, an applicable implementation plan as adopted pursuant to Section 110 of the CAA, an approved implementation procedure or plan under Section 111(c) or Section 111(d) of the CAA, or an approved implementation procedure under Section 112(d) of the CAA.

Climate:

The synthesis of the day-to-day values of the meteorological elements that affect a locality. Synthesis here implies more than simple averaging; it is the long-term manifestations of weather during a specified interval of time over a specified geographical region.

Coloration:

The fidelity of the color of objects as modified by the atmosphere and pollutants in the atmosphere.

Concentration:

A measure of the average density of pollutants usually specified in terms of pollutant mass per unit volume of air (typically in units of microgram per cubic meter ($\mu g/m^3$), or in terms of relative volume of pollutants per unit volume of air (typically in units of parts per million (ppm)).

The relationship between ppm and $\mu g/m^3$ for any substance at standard temperature (25 degrees C) and pressure (760 mm Hg) is:

$$1 \text{ ppm (volume)} = (40.9 \times \text{Molecular Weight})\ \mu g/m^3$$

Contrast:

The difference in radiances emitted from two objects in a scene.

Current Condition:

The current "health" or state of a resource at the time it is measured.

Criteria Pollutants:

Pollutants for which the EPA has established national ambient air quality standards under Section 109 of the Clean Air Act. Present criteria pollutants are: carbon monoxide, lead, nitrogen dioxide, sulfur dioxide, ozone, and particulate matter.

Diffusion, Dispersion:

The physical process of diluting the concentration of a substance by molecular and turbulent motion. In meteorology, the exchange of fluid parcels (and hence the transport of conservative properties) between regions in space, in the apparently random motions of a scale too small to be treated by the equation of motion. In air quality, dispersion and diffusion are often used interchangeably.

Dry Adiabatic Lapse Rate:

The decrease in temperature with height at a rate of 1°C per 100 meters. (See also Atmospheric Stability.)

Dust:

Solid, microscopic-sized materials suspended in the atmosphere in the form of small irregular particles. It imparts a tannish or greyish hue to distant objects. The sun's disk is pale or colorless or has a yellowish tinge at all periods of the day. Dust cannot be a stable component of the atmosphere because it must eventually return back to the earth's surface when winds and turbulence become too weak to bear it aloft. Dust is produced by many natural and artificial sources, volcanic eruptions, salt spray from oceans, blowing solid particles, plant pollen and bacteria, and smoke and ashes of forest fires and industrial combustion processes.

Dust-fall:

Particulate matter subject to removal from the atmosphere by the process of gravity deposition. Usually expressed in terms of mass per area per time (tons/acre/month).

Dust, Fugitive:

Particulate matter composed primarily of soil which is uncontaminated by pollutants resulting from industrial activity. May include emissions from haul roads, wind erosion of exposed soil surfaces and soil storage piles, and other activities in which soil is either removed, stored, transported, or redistributed.

Effective Stack Height:

The height above ground level of the physical stack height plus the plume rise.

Emission Offsets:

Equal or greater reductions in emissions within an airshed or air quality central region to compensate for new or modified existing source emissions.

Environmental Impact Statement (EIS):

A detailed description, with a list of reasonable alternatives of the likely effects of a certain activity located in federal land or land management resources as called for by NEPA. Performed or overseen by the land management agency.

Emissions:

Materials (usually pollutants) released into the atmosphere.

Emissions, Fugitive:

(1) Those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening. (2) Any air pollutants entering the ambient atmosphere other than from a stack.

Emissions Inventory:

A quantitative list of the types and quantities of air pollutants emitted for specified source categories within a specified place or region over a specified period of time. Usually expressed in tons per day.

Emission Rate:

The mass of pollutant emitted per unit of time.

Emission Limitation:

The maximum mass of a pollutant that is permitted to be discharged from a single polluting source; e.g., the number of pounds of fly ash per cubic foot of air that may be emitted from a coal-fired boiler.

Environmental Protection Agency (EPA):

The federal agency with primary responsibility for enforcement of environmental regulations

Existing Sources:

Sources of air pollution which commenced construction prior to August 7, 1977.

Federal Land Manager (FLM):

"With respect to any lands in the United States, the Secretary of the Department with authority over such lands." [Clean Air Act, Section 102(i)], or his/her delegated representative.

Fly Ash:

Unburned particles carried by flue gas.

Gas, Flue or Stack:

The air and pollutants emitted to the atmosphere after a production process or combustion takes place.

Gaussian Model:

A mathematical diffusion model in which the concentration of the pollutant material is distributed according to the normal distribution (the fundamental frequency distribution of statistical analysis) in the crosswind and vertical and sometimes alongwind directions.

Good Engineering Practice (GEP) Stack Height:

The computed height of a stack sufficient to avoid aerodynamic downwash.

Guideline Model (also Recommended Model):

A model specified as "preferred" in the EPA Guideline on Air Quality Models.

Hazardous Air Pollutant:

A pollutant which may cause, or contribute to, an increase in mortality or in serious irreversible, or incapacitating reversible, illness. These pollutants currently include asbestos, beryllium, cadmium, and mercury, PCBs, and others. The EPA has established National Emission

Standards for Hazardous Air Pollutants (NESHAP) which apply to sources emitting these substances.

Haze:

Fine dust or salt particles dispersed through a portion of the atmosphere. The particles are so small that they cannot be felt or individually seen with the naked eye, but they diminish horizontal visibility and give the atmosphere a characteristic opalescent appearance that subdues all colors.

Heavy Metals:

Metallic elements such as mercury, chromium, cadmium, arsenic, and lead, which have high molecular weights. They can damage living things at low concentrations and tend to accumulate in the food chain.

Hi-Volume Sampler (Hi Vol.):

A mechanical device that collects suspended particulates in the atmosphere on a filter for later analysis to determine that atmospheric concentrations of TSPs.

Hydrocarbon:

Any of a vast family of compounds, especially in fossil fuel, containing carbon and hydrogen in various combinations being carcinogenic or active participants in photochemical processes.

Impacts:

(1) Direct effects, which are caused by the action and occur at the same time and place. (2) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Effects and impacts as used in environmental regulations are usually synonymous. Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance, the agency believes that the effects will be beneficial.

Increments:

Allowable increases in ambient concentrations of sulfur dioxide and particulates from new or major modified existing sources. The amount of increase is dependent on whether the area is designated Class I, Class II, or Class III for PSD.

Inversion, Radiation:

An increase in air temperature with height in the surface layer due to radiational cooling of the air near the ground.

Inversion, Elevated:

A temperature inversion (frequently caused by subsidence) with a base above the ground.

Inversion, Subsidence:

Air temperature inversion aloft caused by sinking air within a high pressure system which caused the temperature at the top of the layer to increase more than the temperature at the bottom. The effect is the creation of a limited mixing volume below the stable layer.

Inversion, Temperature:

A layer of the atmosphere where the temperature increases with height. Inversions may exist in many layers simultaneously through the atmosphere. Inversions may be surface based or begin above the surface. Inversions act to trap pollutants below or above them. See radiation, subsidence, and elevated inversions.

Isopleth:

A line of equal or constant value of a given quantity with respect to space or time.

LAER (Lowest Achievable Emission Rate):

A requirement pertinent to proposed new or modified major stationary sources in nonattainment areas. It is the "rate" of emission limitation which is either (a) the most stringent emission limitation contained in the State Implementation Plan (SIP) for such class or category of source, unless the owner or operator of the proposed source demonstrates that this limitation is not achievable, or (b) the most stringent emission limitation which is achieved in practice by such class or category of source, whichever is more stringent. In no event shall the application of this term permit a proposed new or modified source to emit any pollutant in excess of the amount allowable under the applicable New Source Performance Standards.

Lapse Rate:

The change of air temperature with height. A "lapse" condition usually means a decrease with height. See dry adiabatic lapse rate.

Limit of Acceptable Change (LAC):

The human-caused change in the biophysical and social components of an ecosystem that is tolerable, without loss of wilderness character, as described in the Wilderness Act [16 U.S.C. 1131 Sec. 2. (c)].

Limited Mixing Condition:

A type of pollutant dispersion which may occur during light winds when an effluent is released and contained within a limited mixing volume of air beneath an inversion layer. Under these conditions, a plume will usually rise to the top of the surface-based mixing layer and then undergo vertical mixing downward to the surface.

Major Stationary Source and Major Emitting Facility:

Any of the following stationary sources of air pollutants which emit, or have the potential to emit, 100 tons per year or more of any air pollutant from the following types of stationary sources: fossil-fuel fired steam electric plants of more than 250 million BTU per hour heat input, coal cleaning plants (thermal dryers), kraft pulp mills, Portland Cement plants, primary zinc smelters, iron and steel mill plants, primary aluminum ore reduction plants, primary copper smelters, municipal incinerators capable of charging more that 250 tons of refuse per day, hydrofluoric, sulfuric, and nitric acid plants, petroleum refineries, lime plants, phosphate rock processing plants, coke oven batteries, sulfur recovery plants, carbon black plants (furnace process), primary lead smelters, fuel conversion plants, sintering plants, secondary metal production facilities, chemical process plants, fossil fuel boilers of more than 250 million BTU per hour heat input, petroleum storage and transfer facilities with a capacity exceeding 300 thousand barrels, taconite ore processing facilities, glass fiber processing plants, and charcoal production facilities. Such term also includes any other source with the potential to emit 250 tons per year or more of any air pollutant. This term does not include new or modified facilities which are nonprofit health or education institutions which have been exempted by the State.

Meteorological Factors or Elements:

Types of measurements necessary for the consideration of air pollution problems. Generally, these are pressure, temperature, and humidity of the atmosphere, speed and direction of the wind at plume height, and in some cases, the amount of insolation (intensity of the sun or cloud cover and cloud type and height; sometimes the vertical temperature structure is essential).

Microscale:

In meteorology, having characteristic spatial dimensions of about 1 mile or less in the horizontal and a few hundred meters in the vertical. Typical microscale phenomena include dust devils and lake breezes.

Micrograms per Cubic meter ($\mu g/m^3$):

A mass per unit volume measurement commonly used to express concentration of air pollutants.

Mixing Height:

Height of the layer of air through which pollutants are well mixed. It is a function of the vertical temperature structure.

Model:

A representation of theory or reality. See Air Quality Model.

Monitoring, Fixed Station:

The repeated, long-term sampling or measurement of atmospheric pollutants at representative points for the purpose of determining air quality trends and characteristics (either background or existing air quality).

National Ambient Air Quality Standards (NAAQS):

The allowable concentrations of certain air pollutants in the ambient air as specified by the Federal government (40 CFR 50). The primary NAAQS standards allow an adequate margin of safety for the protection of public health while the secondary standards allow an adequate margin of safety for the protection of the public welfare. Both are intended to protect against any unknown or anticipated adverse effects associated with the presence of air pollutants in the ambient air. Public welfare is defined as including but not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate; damage to and deterioration of property; hazards to transportation; and effects on economic values and on personal comfort and well-being.

National Emission Standards for Hazardous Air Pollutants (NESHAP):

Standards of performance for certain identified pollution emission sources for pollutants of a hazardous nature including asbestos, beryllium, mercury, and PCBs (40 CFR 61).

Natural Resources:

Land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the fishery conservation zone established by the Fishery Conservation and Management Act of 1976), any State or local government, or any foreign government.

Nephelometer:

An instrument which measures, at more than one angle, the scattering function or efficiency of particles suspended in a medium.

New Source Performance Standards (NSPS):

A set of standards (typically in tons/Btu) which limit the mass of pollutants released into the atmosphere by industrial source type.

Nitric Oxide (NO):

A gas formed by combustion under high temperature and high pressure in an internal combustion engine. It changes into nitrogen dioxide in the ambient air and contributes to photochemical smog.

Nitrogen Dioxide (NO_2):

The result of nitric oxide combining with oxygen in the atmosphere; a major component of photochemical smog. A criteria pollutant.

Nitrogen, Oxides of (NO_x):

Gases formed in great part from atmospheric nitrogen and oxygen when combustion takes place under conditions of high temperature and pressure. Nitrogen oxides are primary air pollutants which can be harmful themselves as well as act as precursors of photochemical oxidants (particularly ozone).

Nonattainment Area:

A geographical area in which the mean concentration of specific criteria pollutants exceeds the national ambient air quality standards. PSD regulations do not apply in nonattainment areas.

Non-Guideline Model:

A model that is not "preferred" or recommended in the EPA Guideline on Air Quality Models.

Opacity:

(1) The degree of obscuration of light. For example, a clean window has zero opacity, a wall is 100 percent opaque. The Ringlemann Chart for evaluating smoke density is based on opacity. (2) The fraction of a beam of light, expressed in percent, which fails to penetrate a plume of smoke. (3) The degree to which emissions reduce the transmission of light and obscure the view of an object in the view of an object in the background.

Oxidant:

A substance containing oxygen that is capable of oxidizing another substance; in the atmosphere, usually ozone.

Ozone (O_3):

A pungent, colorless toxic gas that contributes to photochemical smog. A Criteria Pollutant.

Particulate Matter (PM):

Any material, except water or gas in a chemically uncombined form, that is or has been airborne and exists as a liquid or solid at standard temperature and pressure conditions. Minute particles of dust, fly ash, fumes and oxides of various metals are examples of particulate material.

Parts per million (ppm):

The number of parts of a given substance related to a million parts of another substance (usually air or water). A unit of measure of gaseous pollutants equivalent to mg/l.

Permitting Authority (usually also the regulator):

Either the EPA Regional Office or the State or District Air Quality Control Agency having the direct responsibility for granting a permit.

Permit, PSD:

A legal document issued by EPA, the State or the District to authorize and/or regulate an activity that adds or may add pollutants to the ambient atmosphere.

Photochemical Reaction:

Chemical reaction that requires light in order to proceed.

Photochemical oxidant:

Air pollutants (including ozone) formed by the action of sunlight on oxides of nitrogen and hydrocarbons.

Plume:

The stream of pollutants emanating from an identifiable source. The volume of air containing any of the substances emitted from a point source. For practical purposes, the limits of a plume have to be arbitrarily defined according to some minimum concentration of the substance.

Plume Rise:

The height attained by a plume from vertical momentum and buoyancy due to heat and molecular-weight difference of material released into the atmosphere. The behavior of this plume, the material contained in a volume of gas, will be influenced by chimney phenomena, surrounding buildings, terrain, as well as the velocity and buoyancy relative to the air and prevailing meteorological conditions.

PM_{10}:

Particulate matter with a diameter equal to or less than 10 micrometers.

Pollution:

The presence of matter or energy whose nature, location, or quantity produces undesired environmental effects.

Pollution Source:

A point, line, area, or volume at which pollution is added to a system, either instantaneously or continuously. Conversely, at a "sink," mass pollution is removed from the atmosphere. Examples of air pollution sources are: a smokestack is a point source, a freeway or aircraft trajectory is a line source, and an entire city is an area source.

Polycyclic Organic Matter (POM):

Industrial Air Pollutants, many of which are known or suspected carcinogens.

Potential to Emit:

The maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment, and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable. Secondary emissions do not count in determining the "potential to emit" capacity of a stationary source.

Precipitation:

In meteorology, any of all the forms of water particles, whether liquid or solid, that fall from the atmosphere and reach the ground. Precipitation includes drizzle, rain, snow, snow pellets, snow grains, ice crystals, ice pellets, and hail.

Precursor:

A pollutant that takes part in a chemical reaction resulting in the formation of one or more pollutants (i.e., NO, NO_2, and VOCs are all precursors for the atmospheric formation of ozone).

Prevention of Significant Deterioration (PSD):

The process incorporated in Sections 160 through 169 of the Clean Air Act which requires emission limitations for certain new or modified sources. The policy is premised on the assumption that air quality is better than ambient air quality standards is a valuable resource that should be protected, particularly around undeveloped areas of special importance such as wilderness and national parks (see also Class I, II, III).

Primary Pollutant:

A pollutant emitted directly from a polluting source.

Primary Standard:

(See Ambient Air Quality Standards.)

Public, The:

In the broadest sense, the people as a whole, the general populace. There are a number of identifiable "segments of the public" which may have a particular interest in a given program or decision. Interested and affected segments of the public may be affected directly by a decision, either beneficially or adversely, they may be affected indirectly, or they may have some other concern about the decision. In addition to private citizens, the public may include, among others, representatives of consumer, environmental, and minority associations; trade, industrial, agricultural, and labor organizations; public health, scientific, and professional societies; civic associations; public officials; and governmental and educational associations.

Radiative Cooling:

The cooling of the earth's surface and adjacent air, accomplished whenever the earth suffers a net loss of heat through terrestrial radiation.

Rawinsonde:

A balloon-borne instrument used to directly measure and radio to a receiving station the vertical structure of temperature, pressure, and relative humidity. Wind speed and direction are computed by radar tracking. Previously, similar instruments, radiosondes, operated in the same fashion except that upper air winds were calculated by tracking the radio signal from the instrument; a less accurate method than radar.

Receptor:

A term typically applied in modeling to the point which receives the pollution. A receptor could be a physical object or a point in space.

Regulated Pollutant:

Specific pollutants listed in the Clean Air Act, the National Emission Standards for Hazardous Air Pollutants (NESHAP), New Source Performance Standards (NSPS), and other statutes.

Resources:

All of the products and physical values produced or contained within the national resource lands. They include the values which are known as renewable and non-renewable natural resources. Examples of the former are timber, range forage and air. Examples of the latter include coal, oil, and ores.

Resource Values Affected by Air Pollution:

A term applied to all biotic and abiotic features on National Forests which may in some way, be applied by air pollution. A term used to distinguish between effects on all lands and AQRVs, effects on just Class I Areas.

Secondary Emissions:

Emissions which would occur as a result of the construction or operation of a major stationary source or major modification, but do not come from the major source or major modification itself. Secondary emissions must be specific, quantifiable, and impact the same general area as the stationary source or modification which produces the primary emissions. May include, but not limited to (a) emissions from ships or trains coming to or leaving the facility, and (b) emissions from any off-site support facility which would not otherwise be constructed or increase its emissions.

Secondary NAAQS:

(See National Ambient Air Quality Standards.)

Secondary Pollutants:

Pollutants formed in the atmosphere by chemical changes taking place between primary pollutants and sometimes other substances present in the air.

Sensitive Receptor:

A species or aspect of the wilderness ecosystem that serves as a sign or symptom of change (also sometimes called AQRV indicator).

Significant Impairment:

Visibility impairment which interferes with the management, protection, preservation or enjoyment of the visitor's visual experience of the mandatory Class I areas. This determination must be made on a case-by-case basis taking into account the geographic extent, intensity, duration, frequency and time of the visibility impairment, and how these factors correlate with (a) times of visitor use of the mandatory Class I area, and (b) the frequency and timing of natural conditions that reduce visibility.

Smoke:

(1) Solid or liquid particles under 1 micron in diameter.
(2) Particles suspended in air after incomplete combustion of materials containing carbon.
(3) The matter in the exhaust emissions which obscure the transmission of light.

Source (Pollution Source):

A point, line, area, or volume at which pollution is added to a system either instantaneously or continuously. Examples of air pollution sources are: a smokestack (point source), a freeway or aircraft trajectory (line source), and an entire city (area source).

Stability, Atmospheric:

A measure of the vertical density gradient of the atmosphere or roughly, the ability of the atmosphere to mix vertically. The broadest divisions of atmospheric stability are stable, neutral, and unstable.

a. stable - temperature increases with height (temperature inversion) or the temperature decreases less than the adiabatic lapse rate (subadiabatically). Vertical mixing is inhibited.

b. neutral - temperature does not change with height (isothermal layer). Vertical mixing is neither enhanced nor inhibited.

c. unstable - temperature decreases with height faster than the adiabatic lapse rate (superadiabatically). Vertical mixing is enhanced.

Stability Wind Rose:

A climatological summary relating the distributions of wind direction, wind speed, and atmospheric stability.

Stack:

Any chimney, flue, conduit, or duct which conducts emissions to the ambient air.

Stagnation Potential:

The high pollution potential which occurs as a result of a large scale high pressure subsidence, low transport wind speeds, or limited mixing heights over a region for extended periods of time, permitting an abnormal buildup of pollutants from sources within the region.

State Implementation Plan (SIP):

A document prepared by the state regulatory agency and approved by the EPA which describes a comprehensive plan of action for achieving specified air quality objectives and standards for a particular locality or region within a specified time period.

Sulfate (SO_4):

A compound in which the hydrogen of sulfuric acid is replaced by either a metal or by an inorganic radical, to become a sulfate salt or sulfate ester, respectively.

Sulfite (SO_3):

A compound in which the hydrogen of sulfurous acid is replaced by either a metal or by an organic radical, to become a sulfite salt or sulfite ester, respectively.

Sulfur Dioxide (SO_2):

A heavy, pungent, colorless gas formed primarily by the combustion of fossil fuels. This major air pollutant is unhealthy for plants, animals, and people.

Teleradiometer:

A device used to measure the contrast between the horizon sky and a surface target.

Total Suspended Particulates:

The total mass of particulates collected on a filter of a standard Hi-Volume sampler measured over a given time period.

Toxic Substances:

Chemicals or mixtures that may present an unreasonable risk of injury to health or the environment.

Trace Element:

A chemical element found in small quantities (less than 1 percent) in a mineral or compound.

Transport:

A term used in modeling for the atmospheric mechanism of moving pollutants downwind. Advection.

Transmissometer:

A device to measure the radiance loss from a known light source over a known distance from which visual range can be implied.

Turbidity:

A measure of the attenuation of solar radiation along the line of sight in hazy air due to the presence of particles and aerosols.

Unclassified Area:

A geographically distinct area for which no ambient air quality data exist and so the area cannot be classified either as attainment or nonattainment. In most cases, an unclassified area is treated by the regulator as an attainment area.

Upper Level Winds:

The winds normally sampled several heights above the earth's surface often used to determine vertical temperature for determination of atmospheric stability and to transport wind speed at plume height and direction minimally influenced in direction and speed by terrain features.

Visibility:

In air pollution, the visual quality of a scene. Visibility includes visual range, contrast and coloration.

Visibility Impairment:

Any humanly perceptible change in visibility (visual range, contrast, coloration). See section 169(g)6 of the Clean Air Act.

Visual Range:

How far an object can be seen by the human eye. The distance under daylight conditions at which the contrast between a specified type of target and its background becomes just equal to the threshold contrasts of an observer. A first order approximation of daytime visual range is meteorological range which is the distance at which the human eye, with a threshold brightness contrast of 0.02 at a wavelength of 5000 angstroms, can detect an ideal black object against the horizon of the sky.

Wind Direction:

The direction from which the wind is blowing.

Wind, Prevailing:

The direction from which the wind blows most frequently. Prevailing wind data are often segregated according to speed or time of day or season.

Wind Rose:

Any one of a class of diagrams designed to show the distribution of wind direction and speed experienced at a given location over a given period of time. The most common form consists of a circle from which sixteen lines emanate, one for each compass point. The length of each line is proportional to the frequency of wind from that direction. The width of the line often is used to designate the frequency of wind speed. The frequency of calm conditions is often entered as a number in the center.

Windspeed:

The rate of movement of air. Pollution transport occurs as a function of the speed of the atmospheric motions in the alongwind (x), crosswind (y) and vertical (z) directions.

Winds, Surface:

Winds close to the earth's surface which are influenced in direction and speed by frictional interaction with the terrain.

APPENDIX A

3-HOUR AND 24-HOUR TRAJECTORIES FOR JARBIDGE WILDERNESS AREA

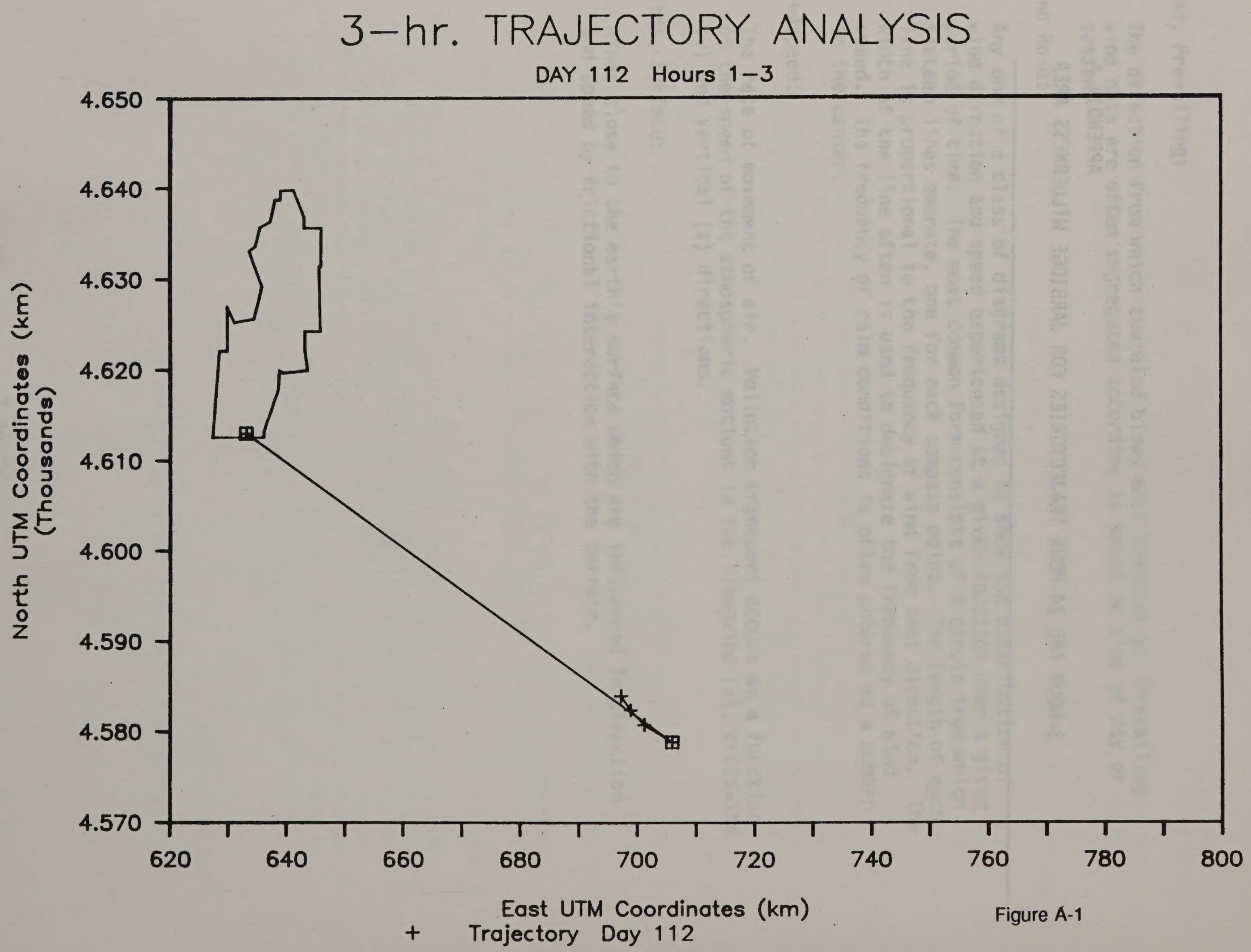

3–hr. TRAJECTORY ANALYSIS
DAY 112 Hours 1–3
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 112

Figure A-1

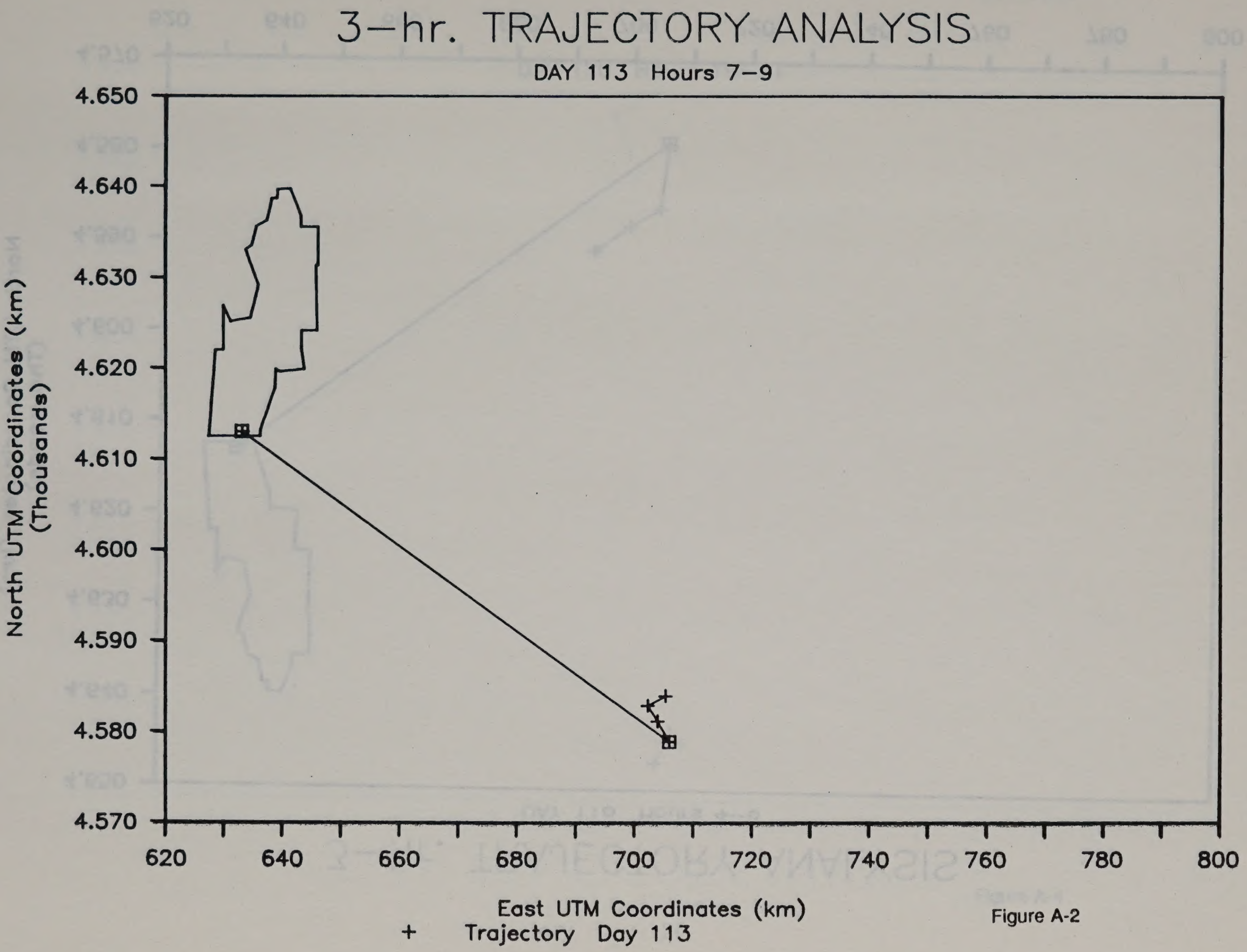

3–hr. TRAJECTORY ANALYSIS
DAY 113 Hours 7–9
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 113

Figure A-2

3–hr. TRAJECTORY ANALYSIS

DAY 118 Hours 4–6

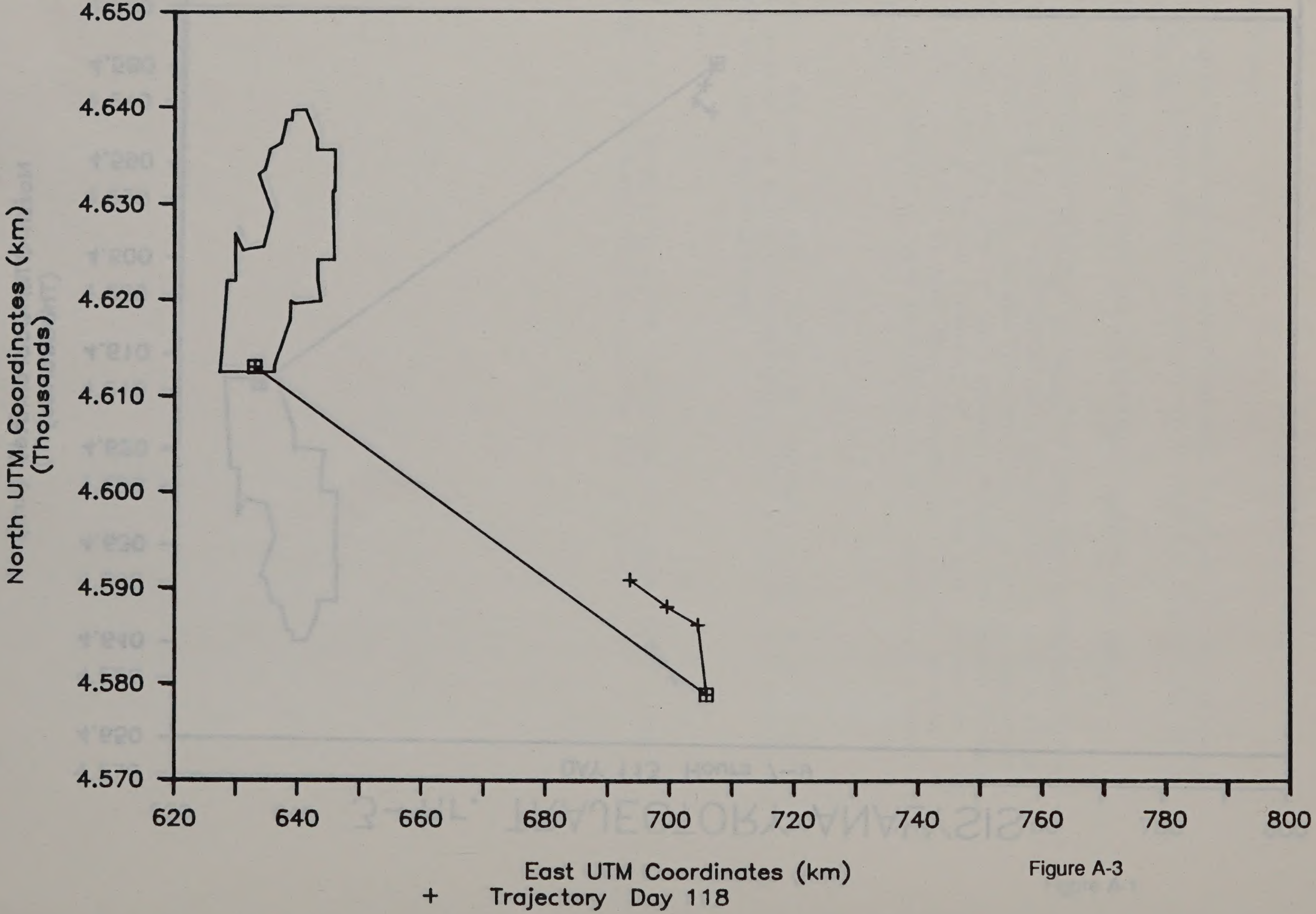


Figure A-3

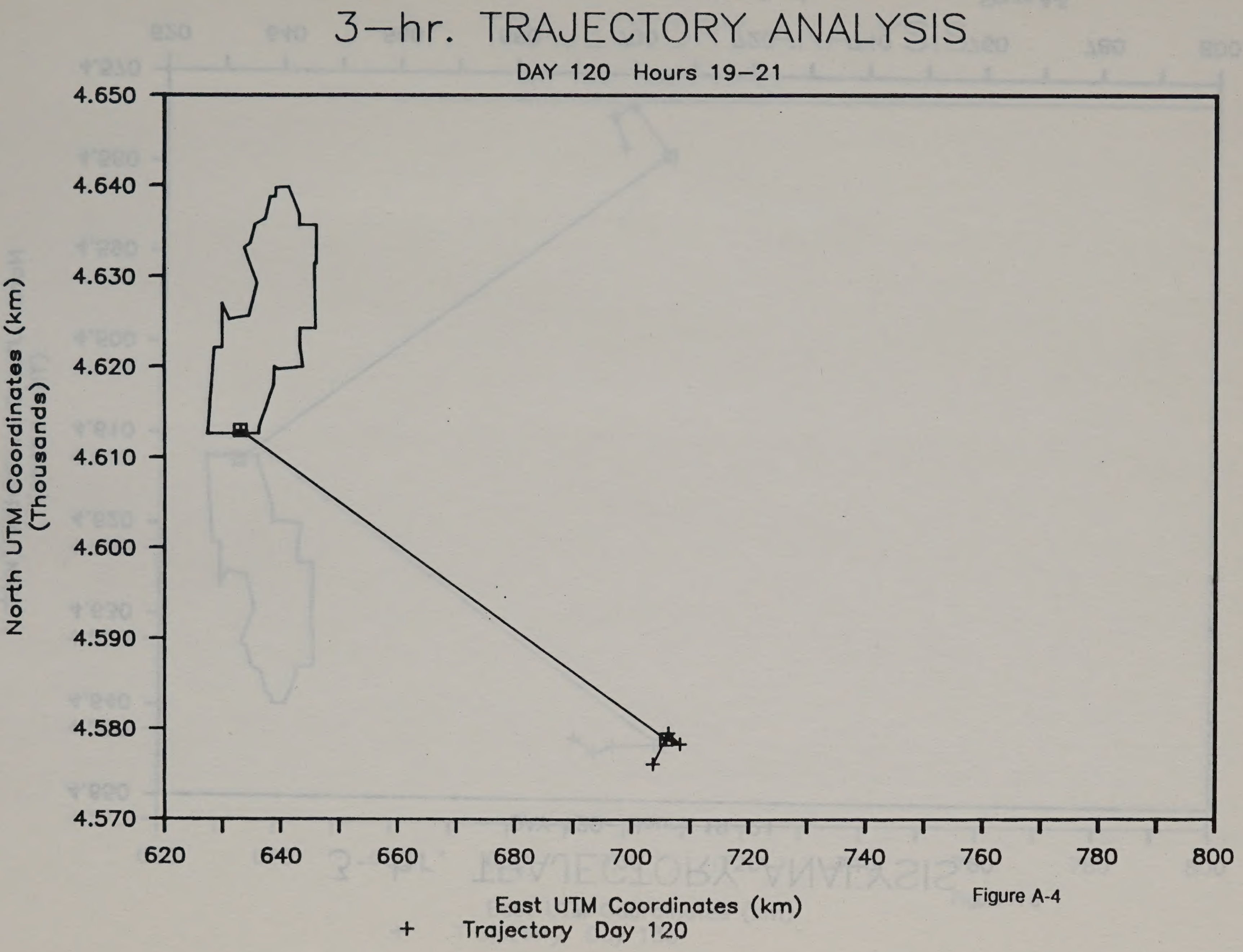

3-hr. TRAJECTORY ANALYSIS
DAY 120 Hours 19-21
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 120

Figure A-4

3–hr. TRAJECTORY ANALYSIS

DAY 129 Hours 19–21

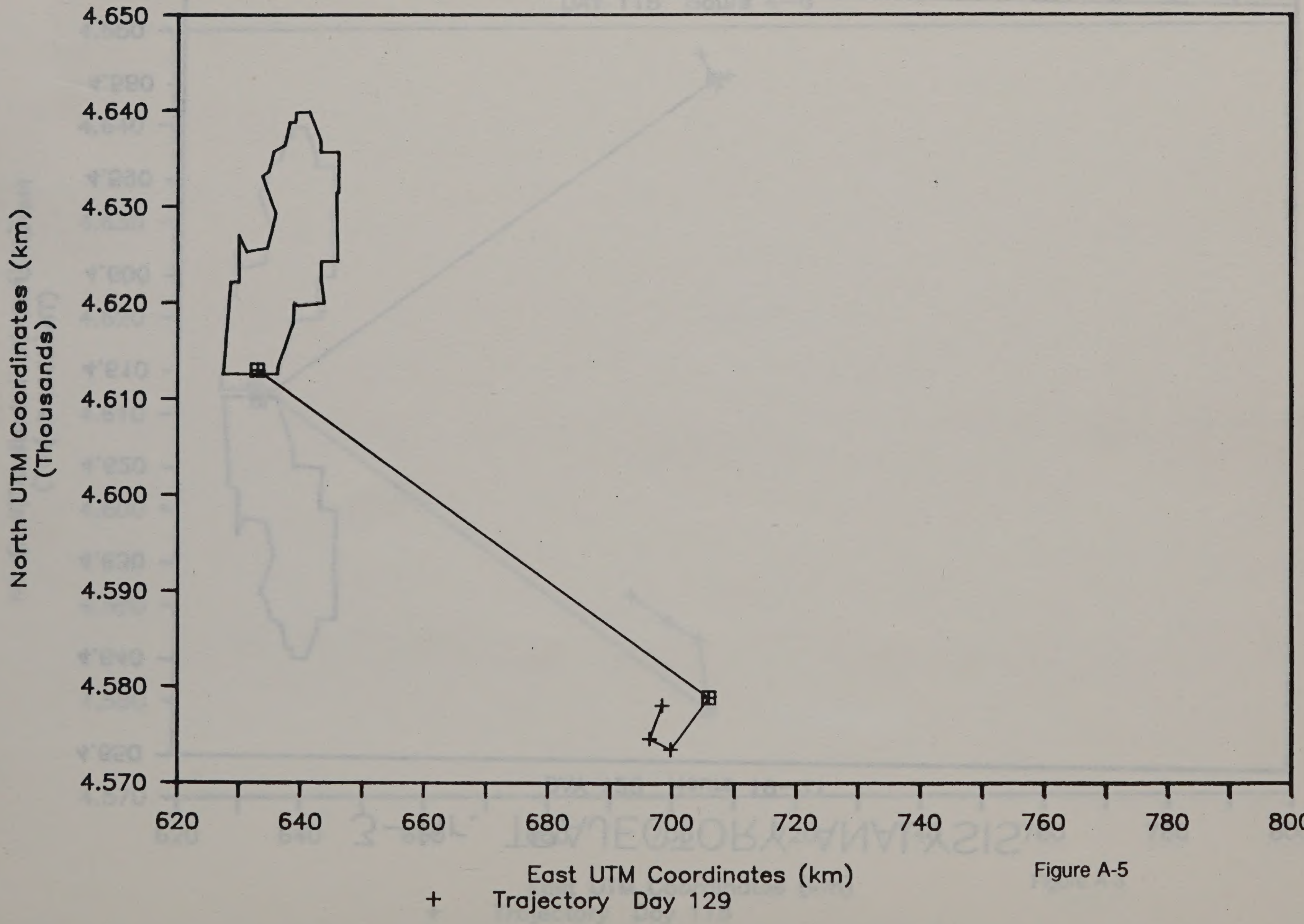


Figure A-5

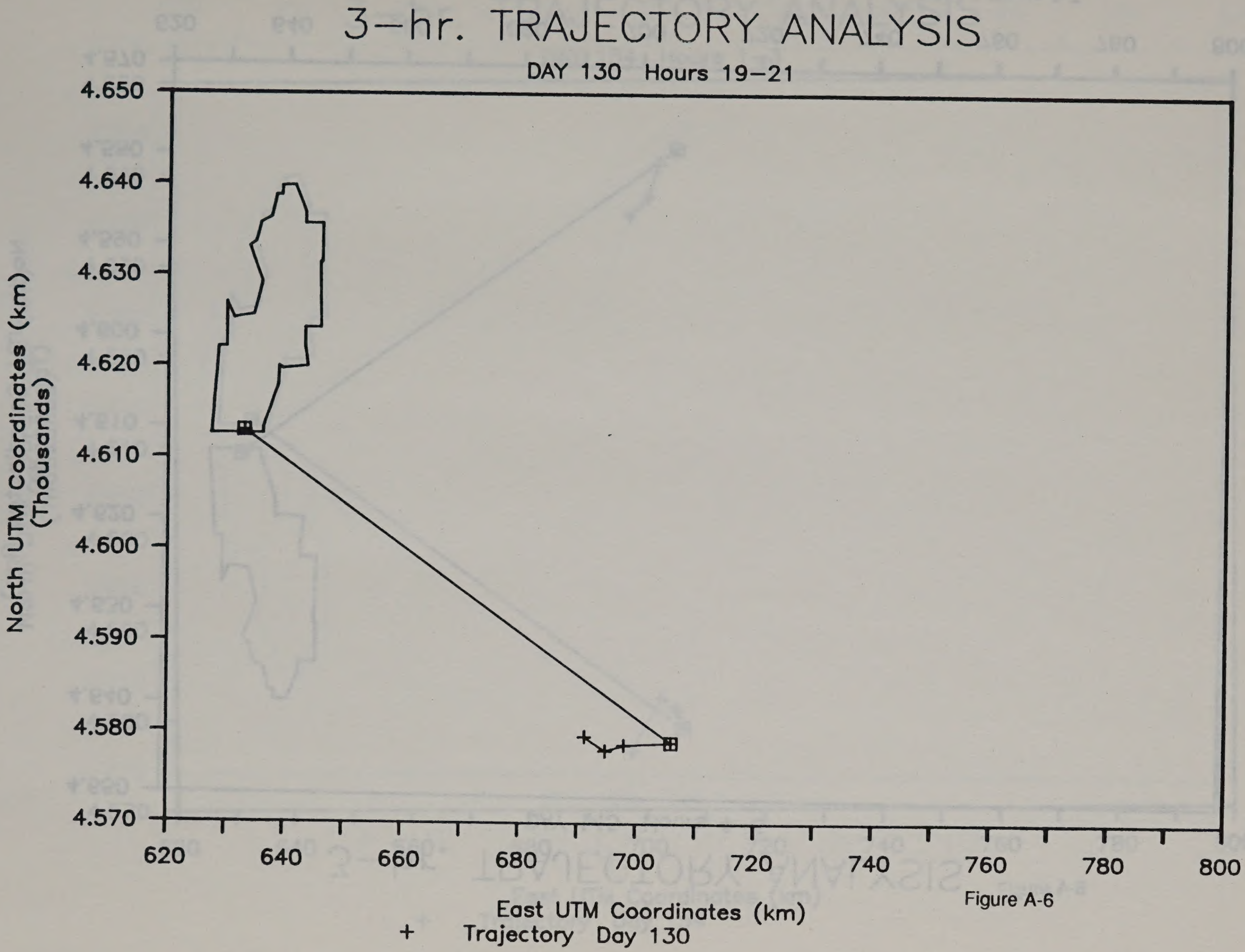

3–hr. TRAJECTORY ANALYSIS
DAY 130 Hours 19–21
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 130

Figure A-6

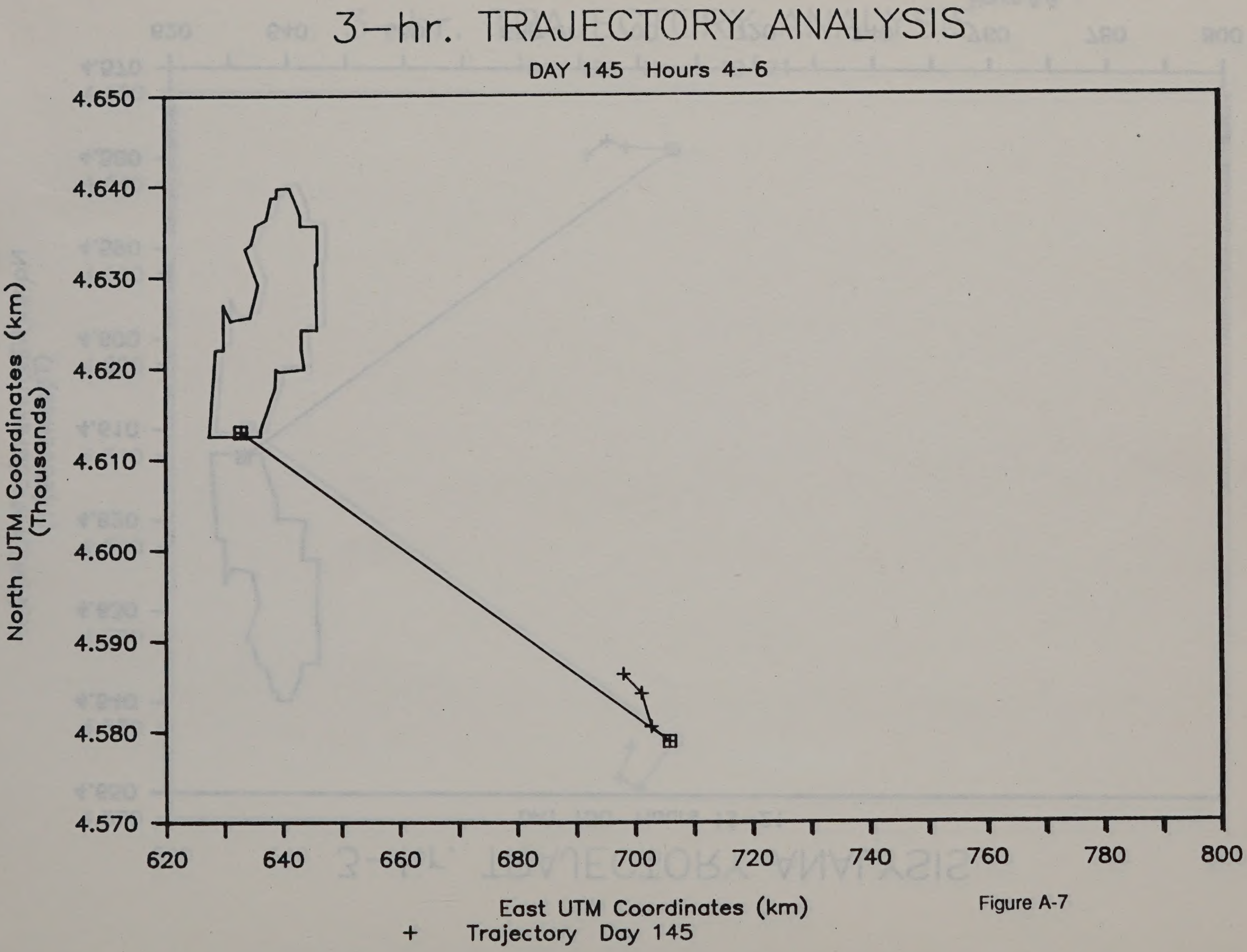

3-hr. TRAJECTORY ANALYSIS
DAY 145 Hours 4-6
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 145

Figure A-7

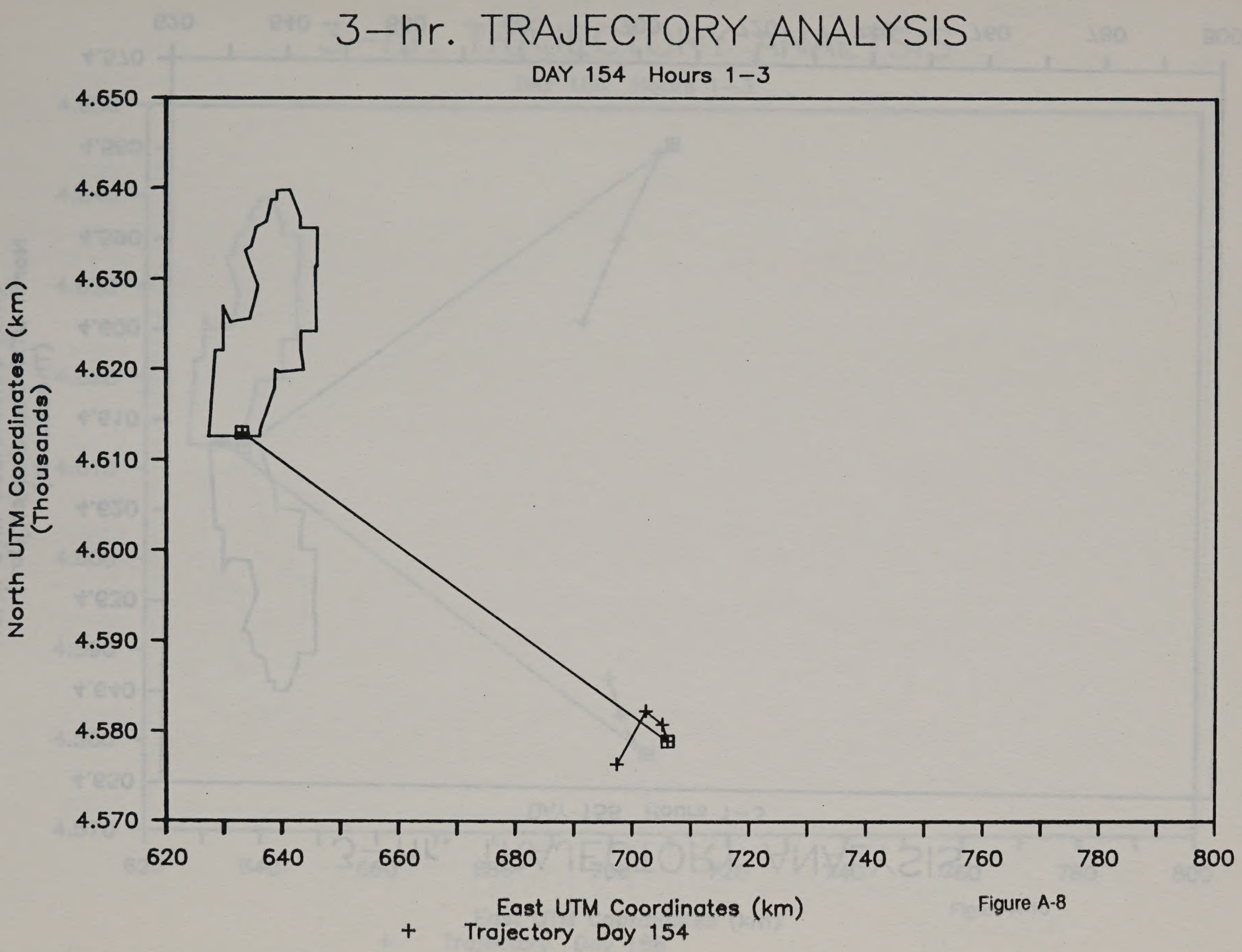

3–hr. TRAJECTORY ANALYSIS
DAY 154 Hours 1–3
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 154

Figure A-8

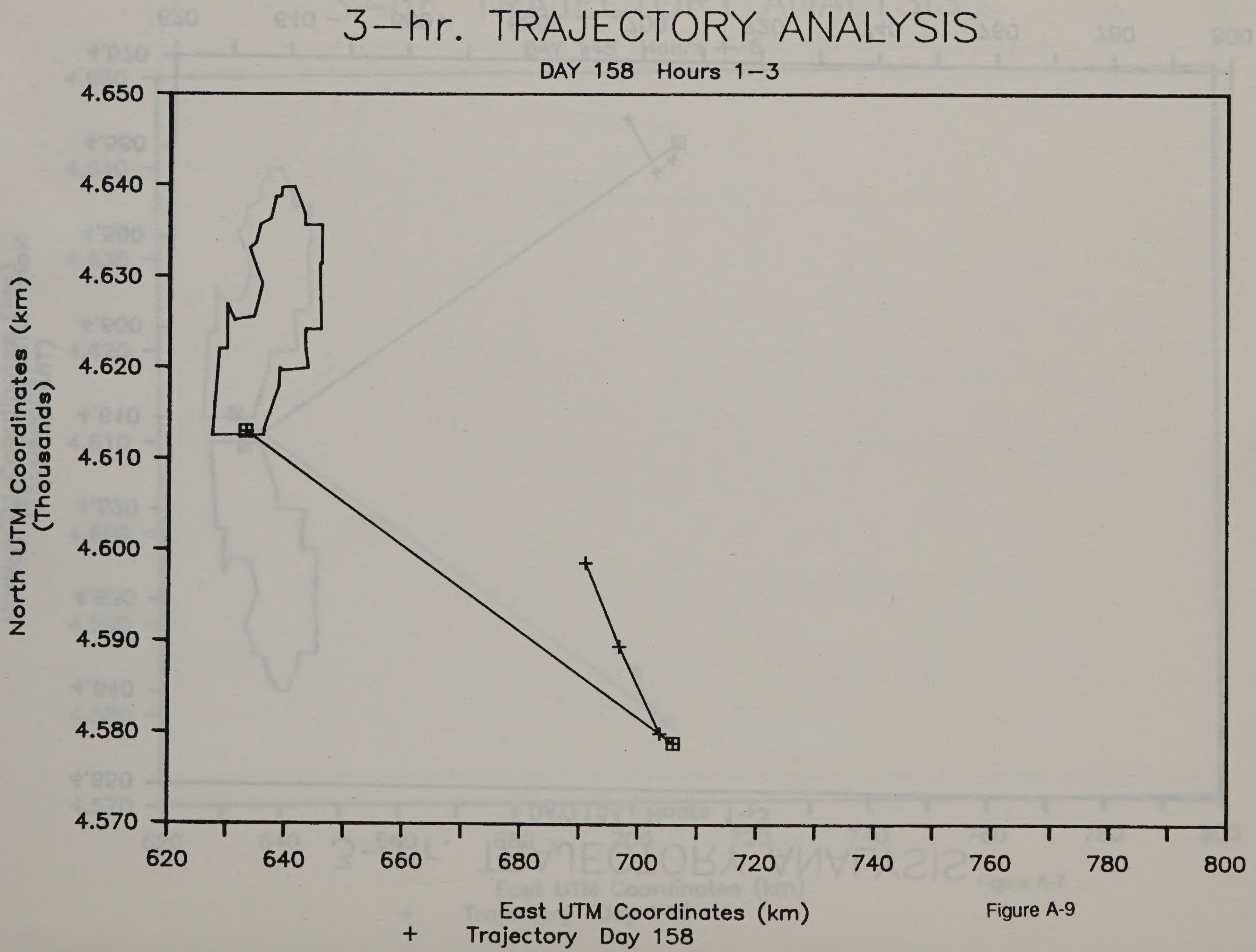

3–hr. TRAJECTORY ANALYSIS
DAY 158 Hours 1–3
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 158

Figure A-9

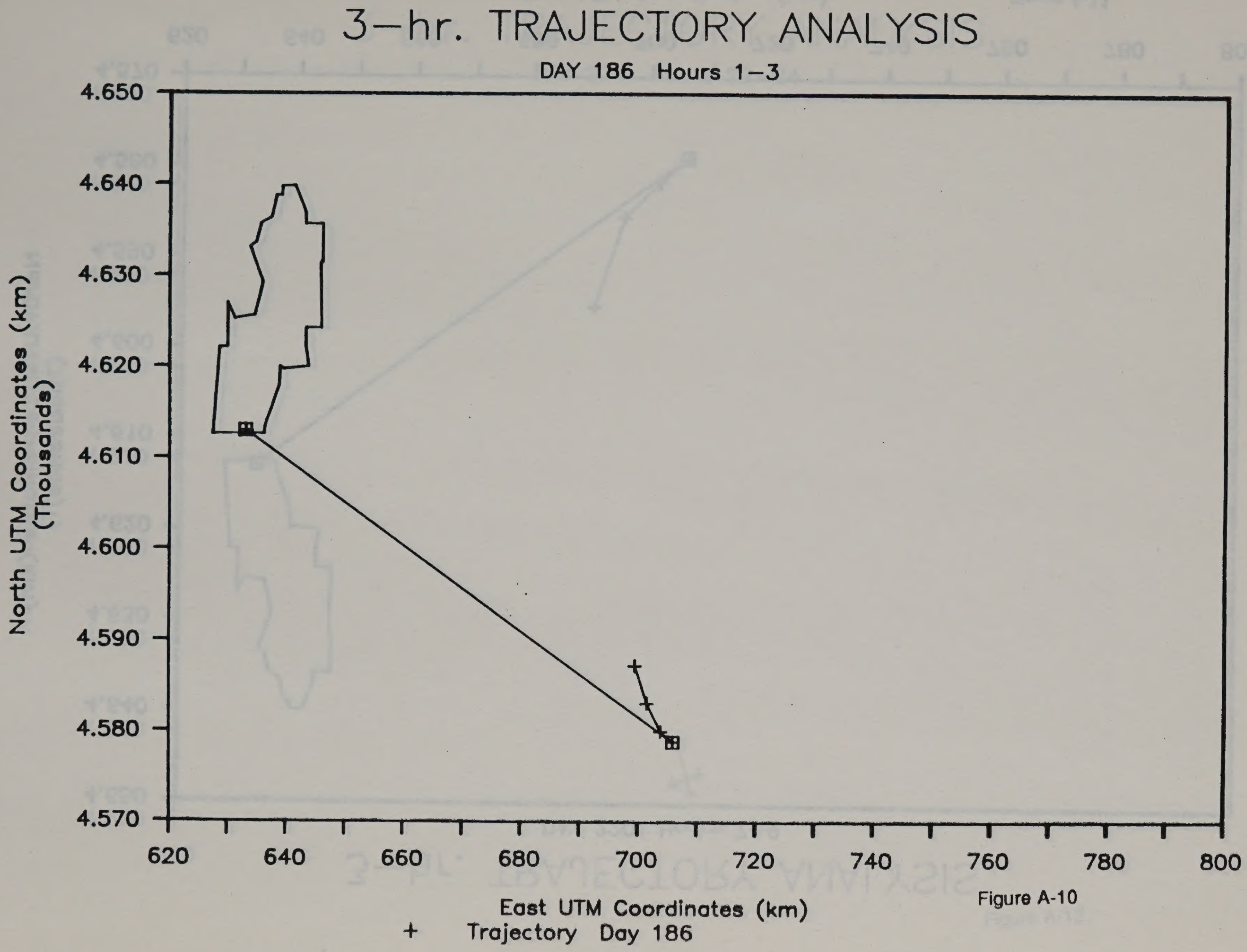

3-hr. TRAJECTORY ANALYSIS
DAY 186 Hours 1-3
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 186

Figure A-10

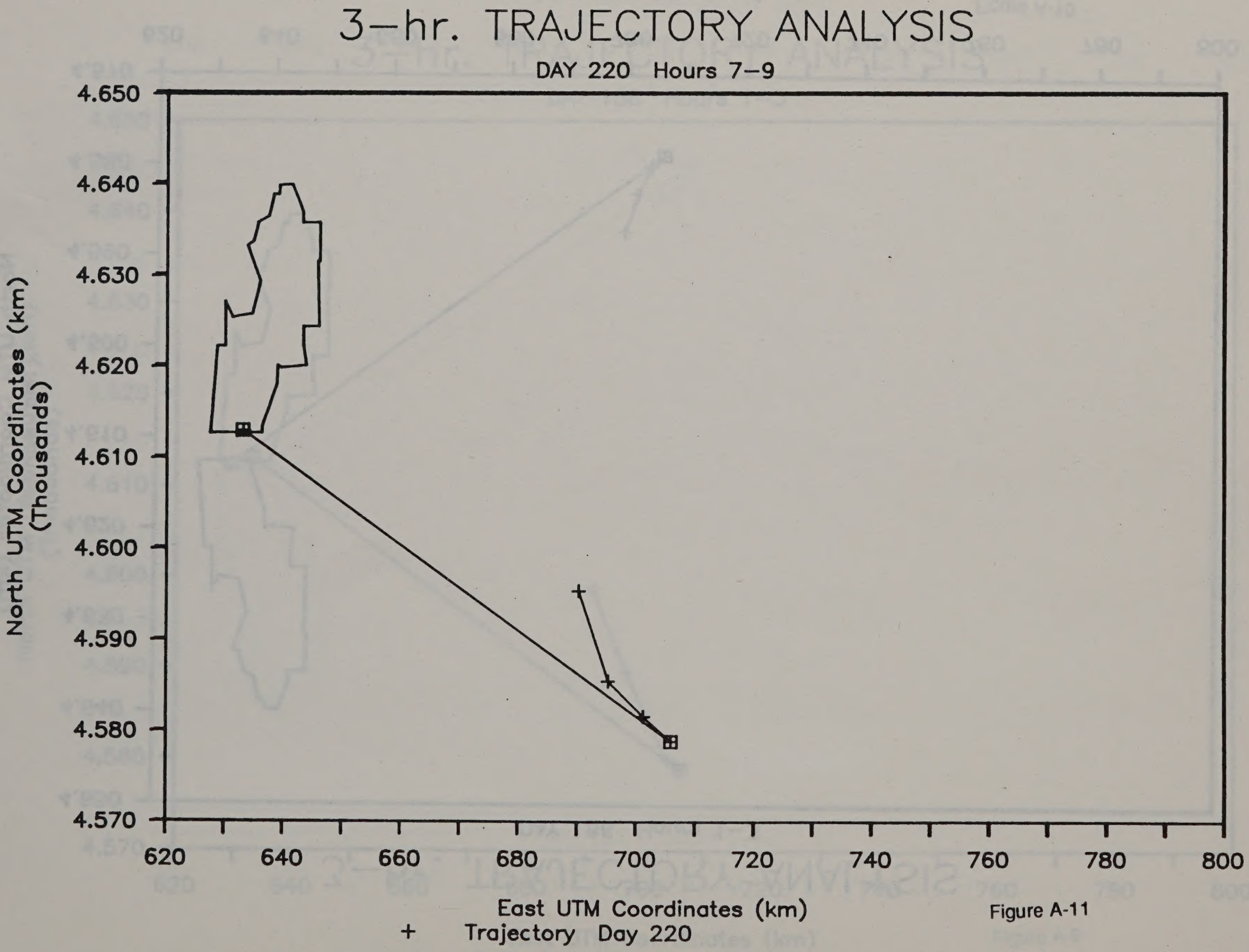

3–hr. TRAJECTORY ANALYSIS
DAY 220 Hours 7–9
North UTM Coordinates (km) (Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 220

Figure A-11

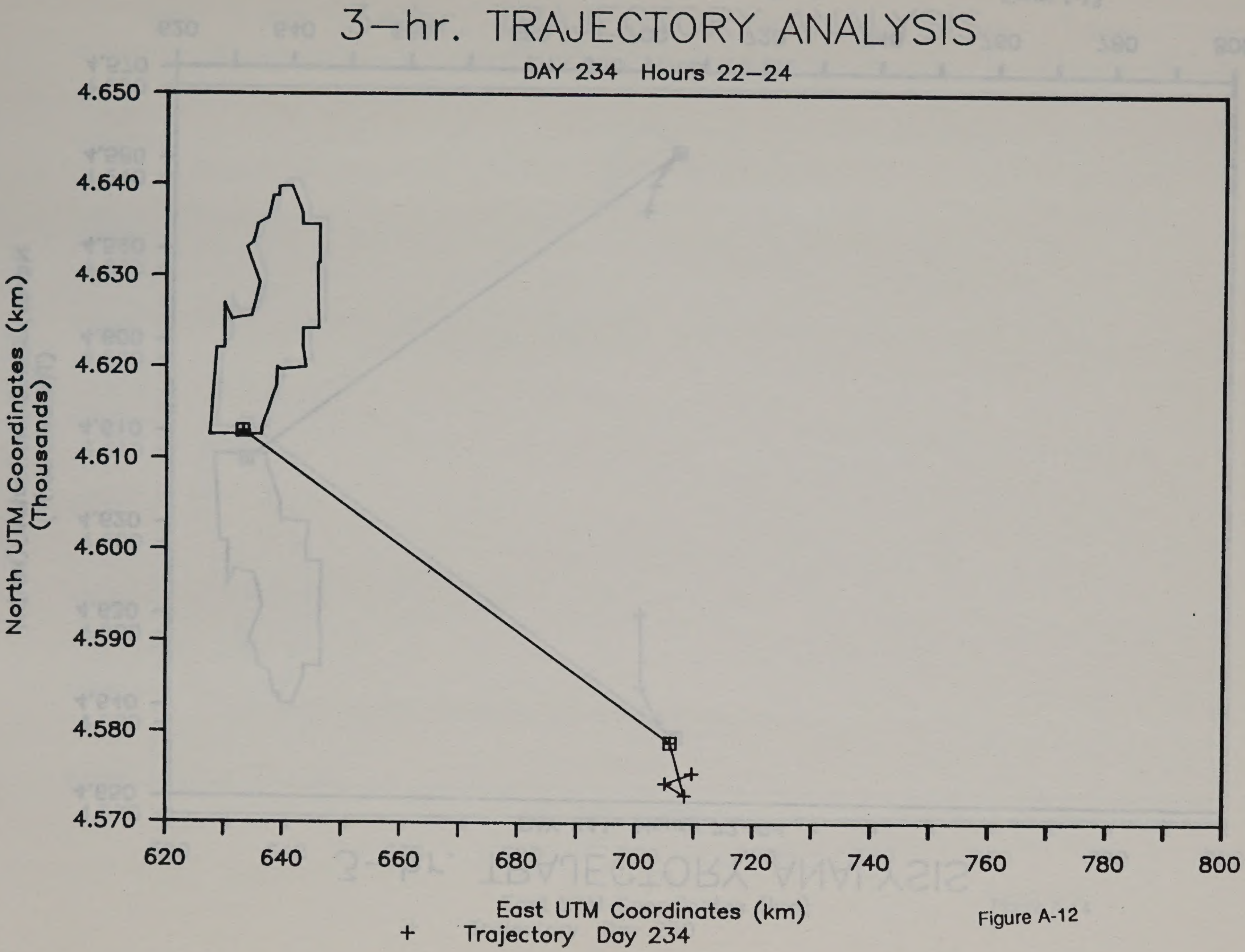
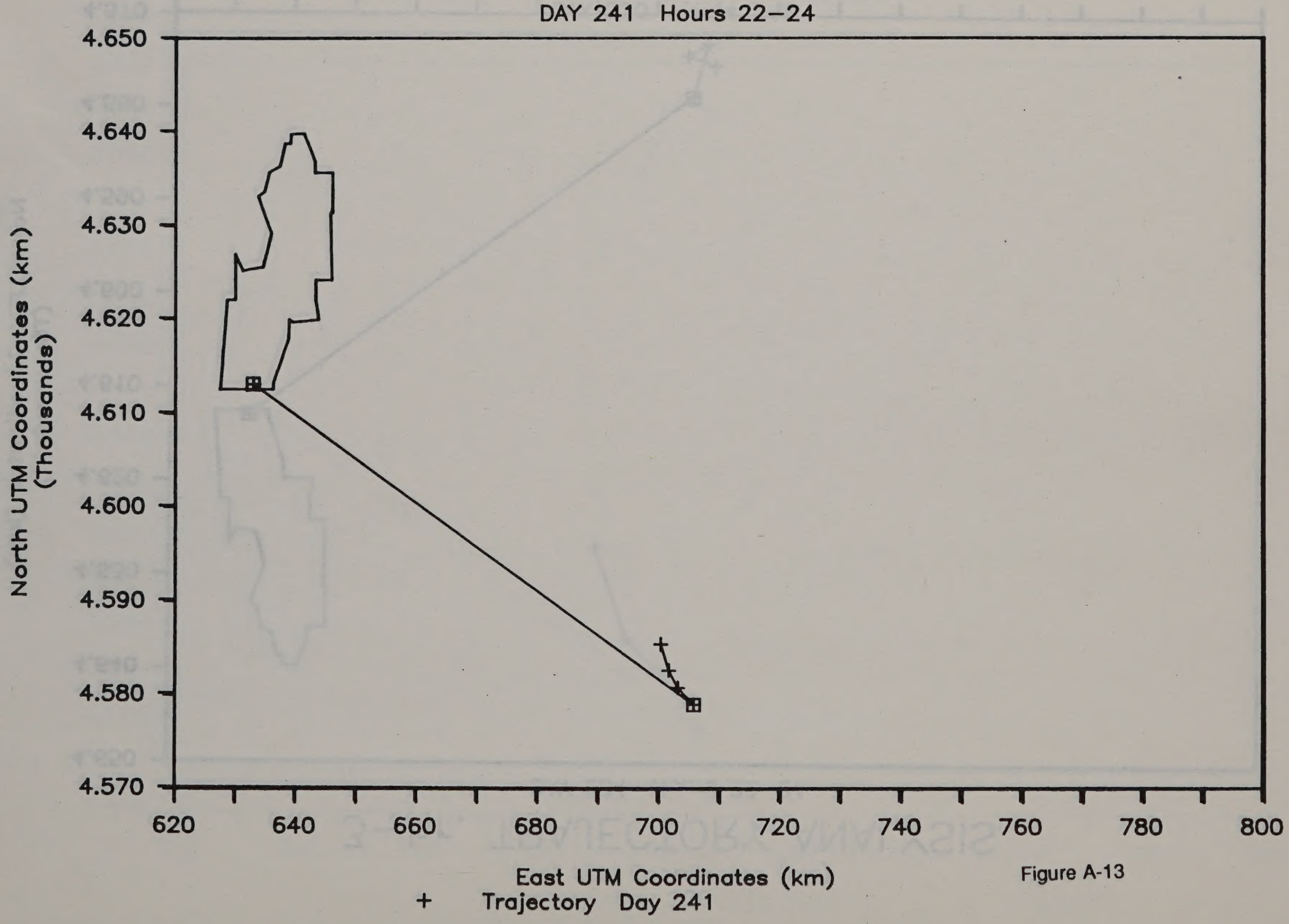

3–hr. TRAJECTORY ANALYSIS
DAY 234 Hours 22–24
North UTM Coordinates (km) (Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 234

Figure A-12



3—hr. TRAJECTORY ANALYSIS

DAY 241 Hours 22—24

Figure A-13

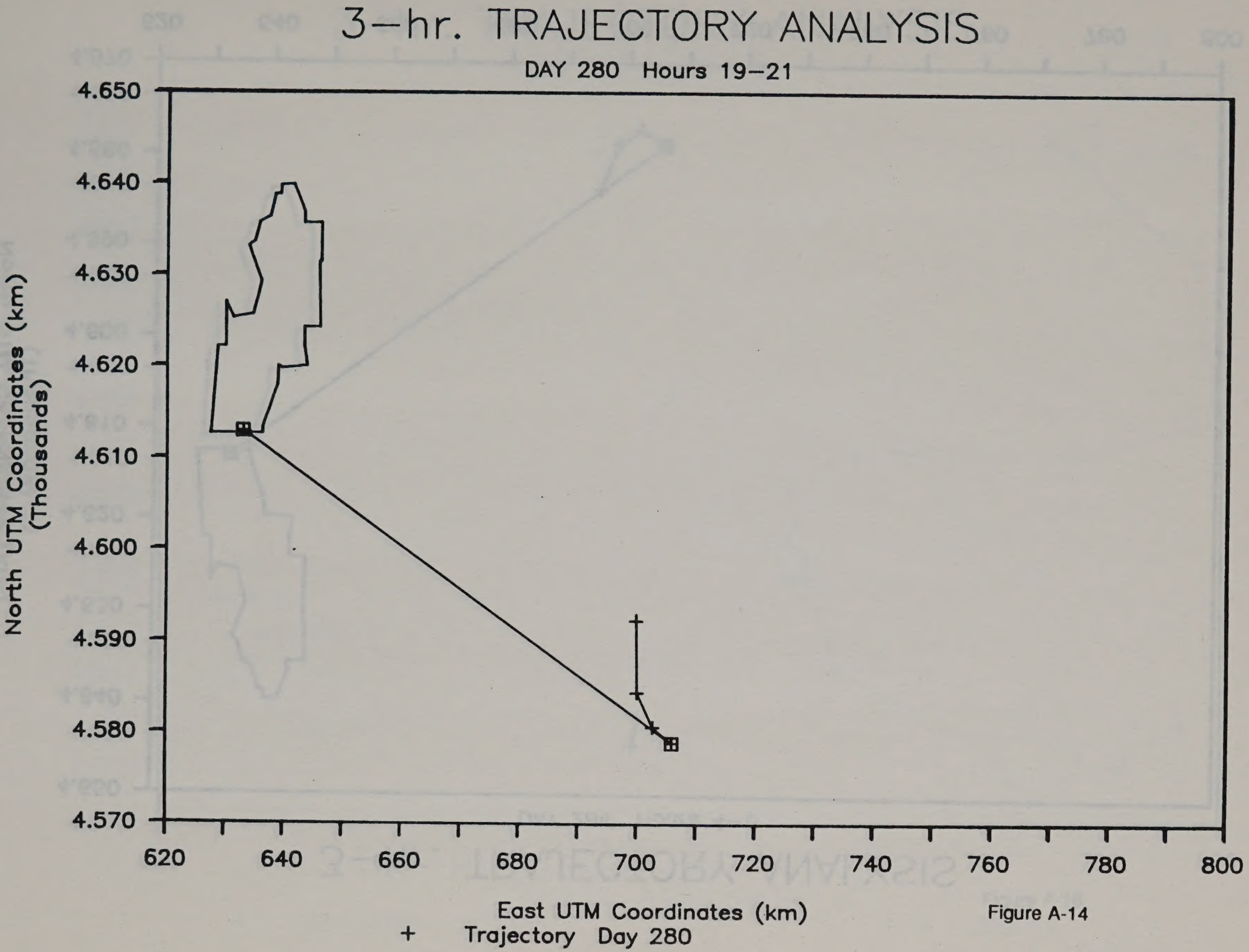
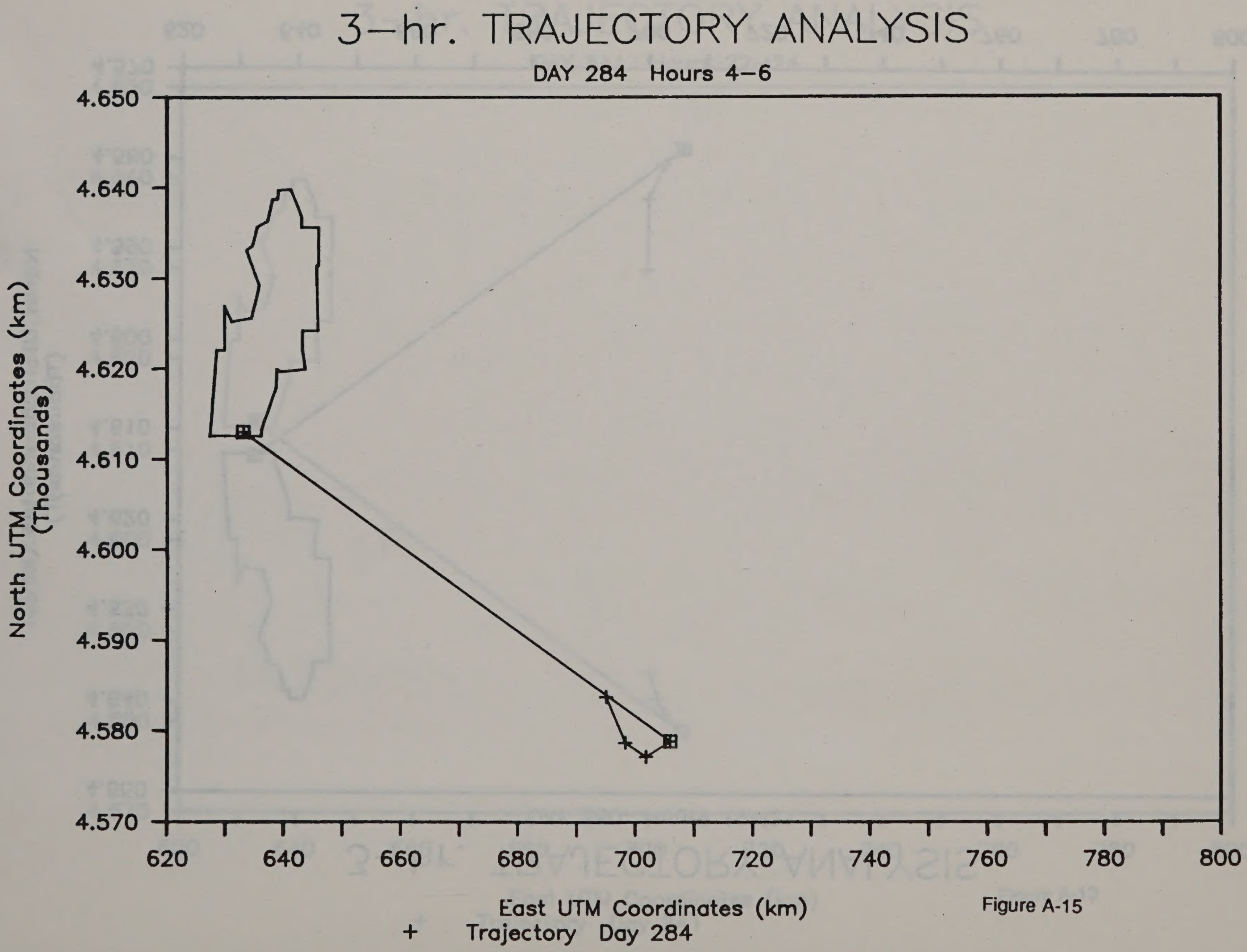

3–hr. TRAJECTORY ANALYSIS
DAY 280 Hours 19–21
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 280

Figure A-14



3-hr. TRAJECTORY ANALYSIS

DAY 284 Hours 4-6

Figure A-15

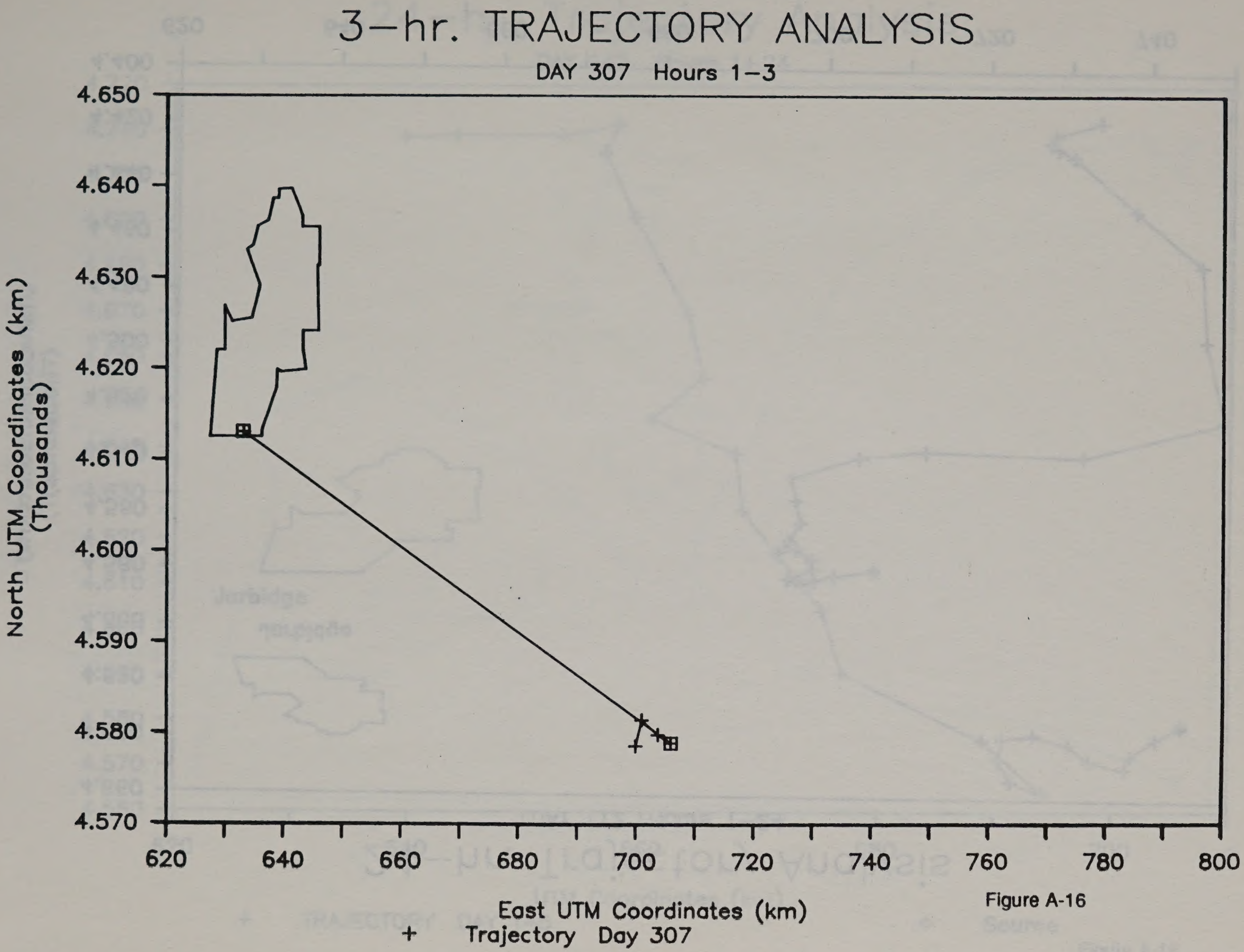

3-hr. TRAJECTORY ANALYSIS
DAY 307 Hours 1-3
North UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
620
640
660
680
700
720
740
760
780
800
East UTM Coordinates (km)
+ Trajectory Day 307

Figure A-16

24–hr. Trajectory Analysis

DAY 112 Hours 1–24

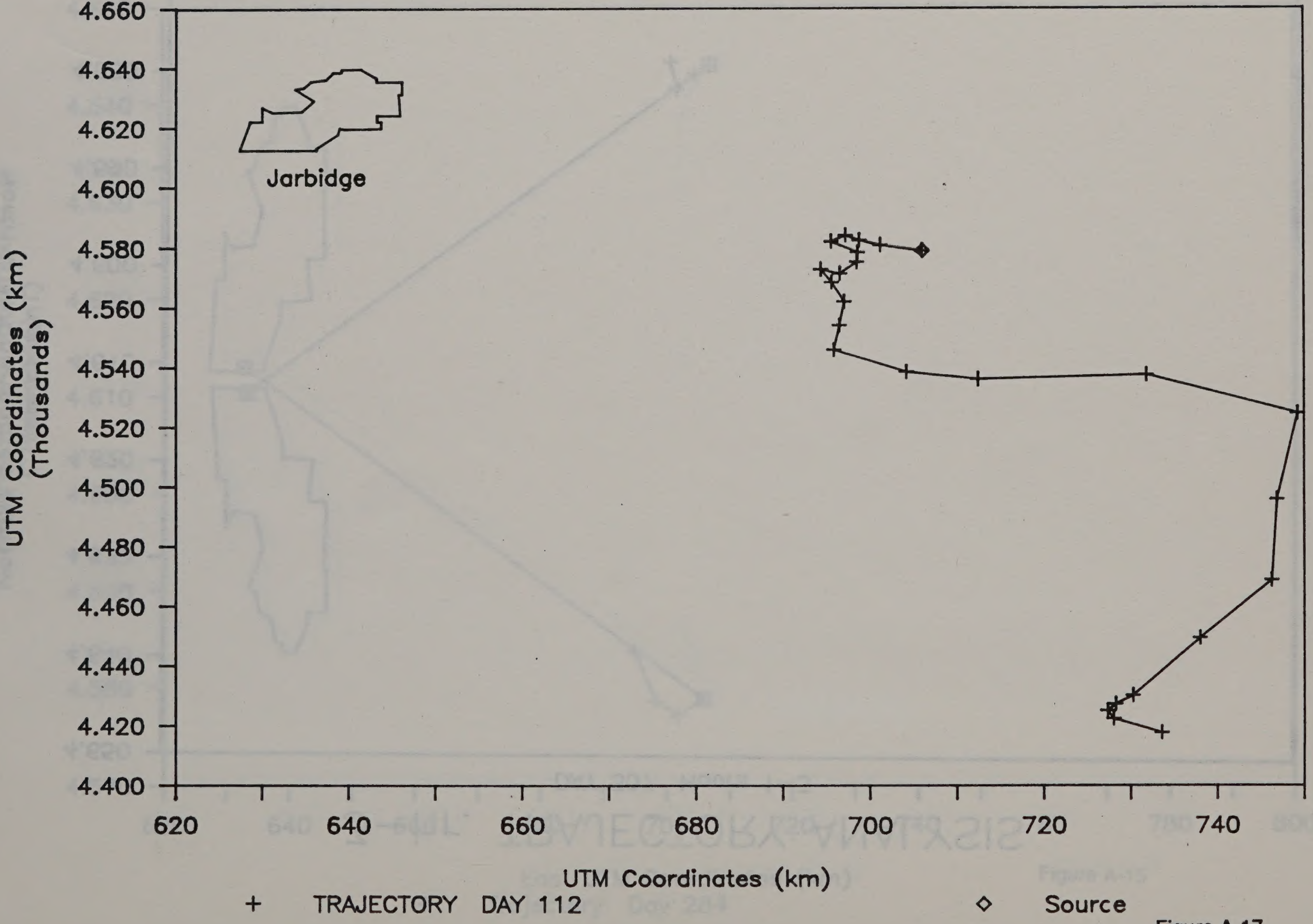


Figure A-17

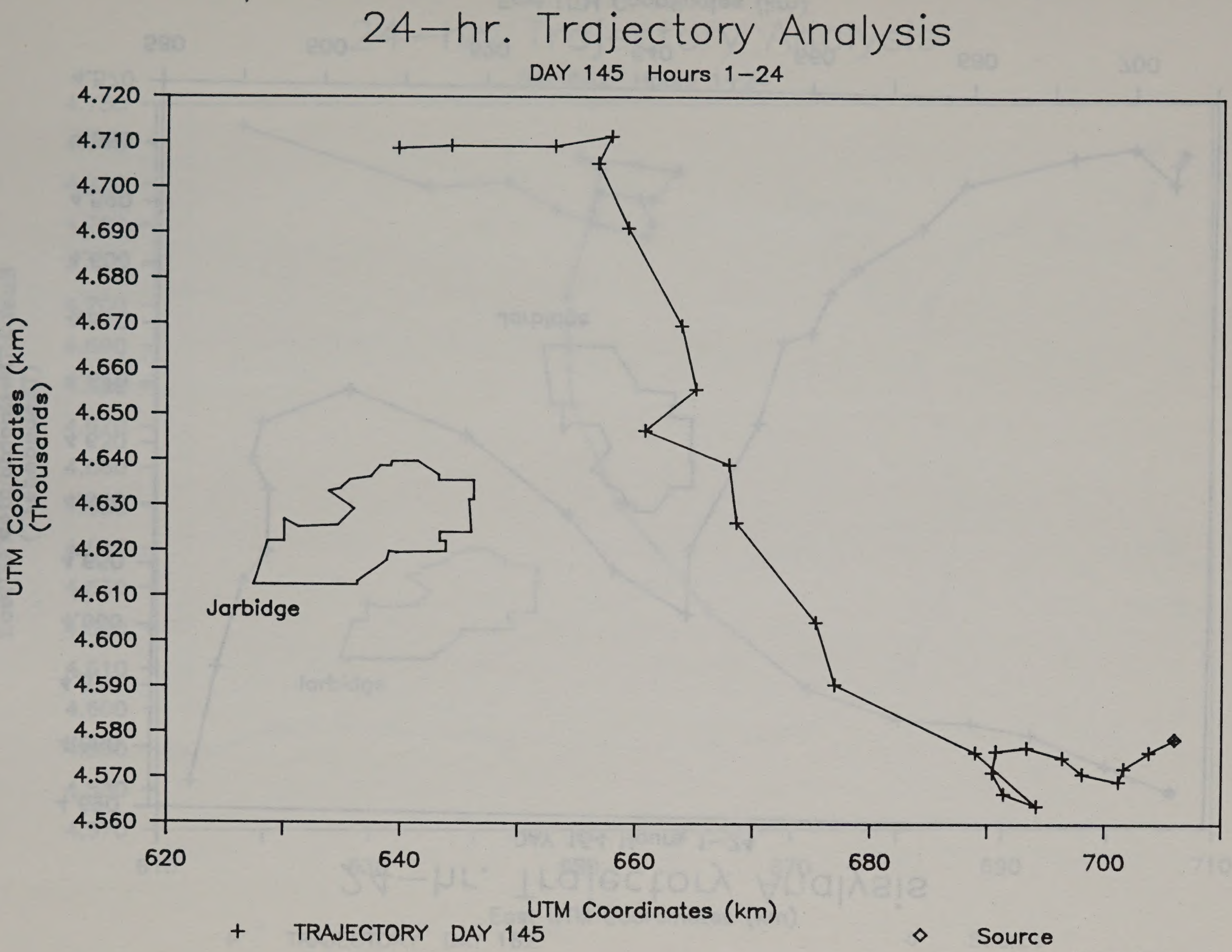

24–hr. Trajectory Analysis
DAY 145 Hours 1–24
4.720
4.710
4.700
4.690
4.680
4.670
4.660
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
4.560
UTM Coordinates (km)
(Thousands)
Jarbidge
620
640
660
680
700
UTM Coordinates (km)
+ TRAJECTORY DAY 145
◇ Source

Figure A-18

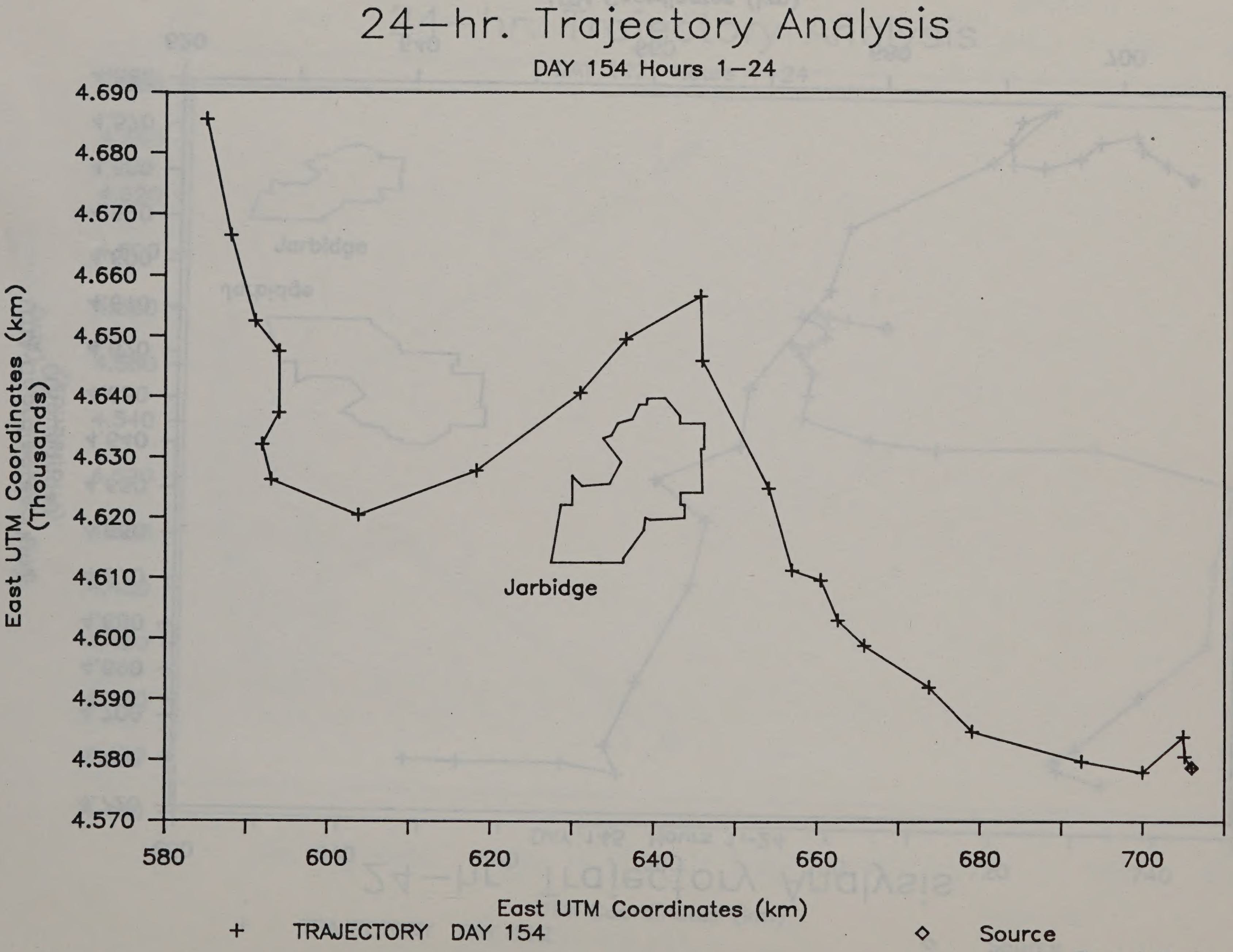

24–hr. Trajectory Analysis
DAY 154 Hours 1–24
East UTM Coordinates (km) (Thousands)
4.690
4.680
4.670
4.660
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
580
600
620
640
660
680
700
East UTM Coordinates (km)
Jarbidge
+ TRAJECTORY DAY 154
◇ Source

Figure A-19

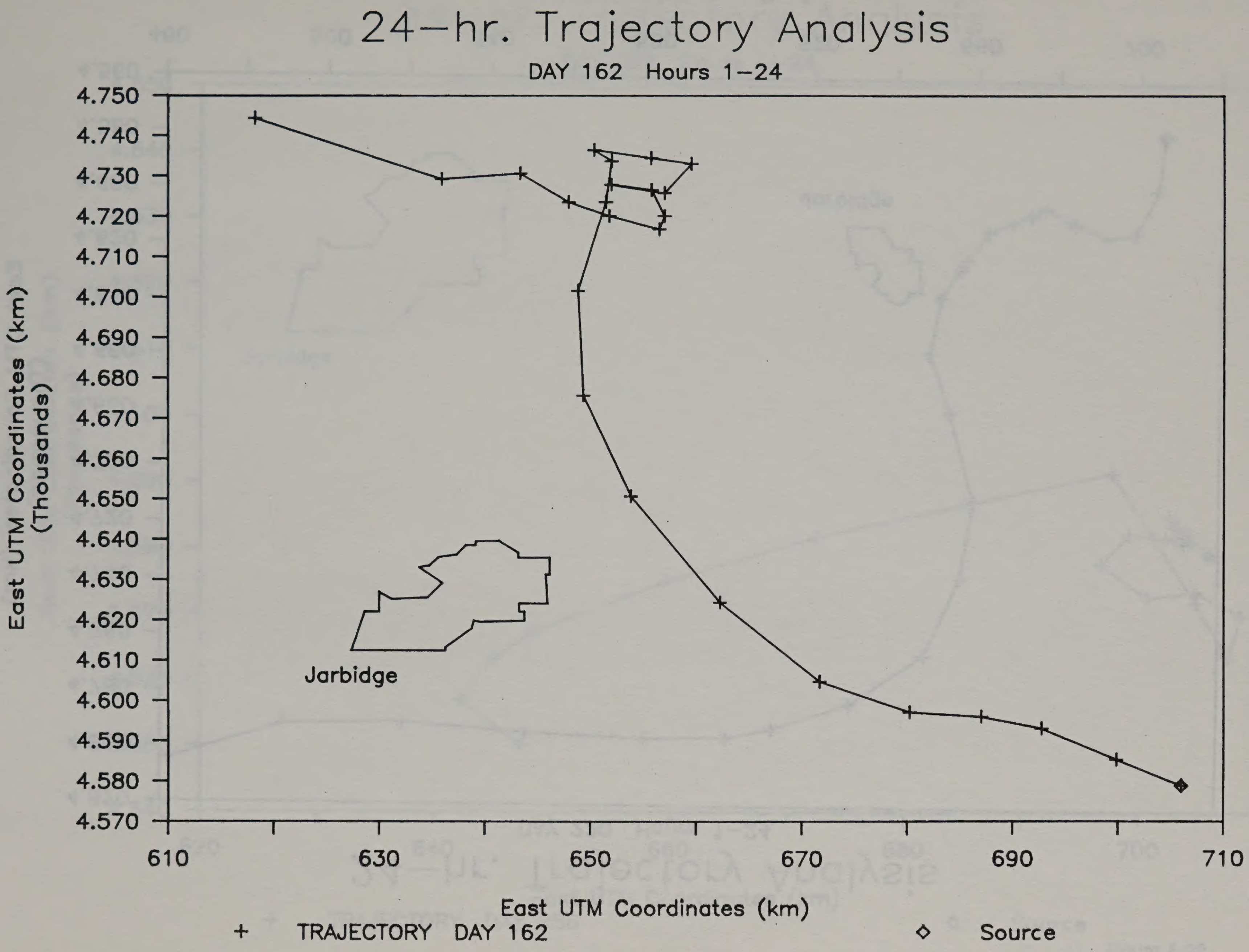

24-hr. Trajectory Analysis
DAY 162 Hours 1-24
East UTM Coordinates (km)
(Thousands)
4.750
4.740
4.730
4.720
4.710
4.700
4.690
4.680
4.670
4.660
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
610
630
650
670
690
710
East UTM Coordinates (km)
Jarbidge
+ TRAJECTORY DAY 162
◇ Source

Figure A-20

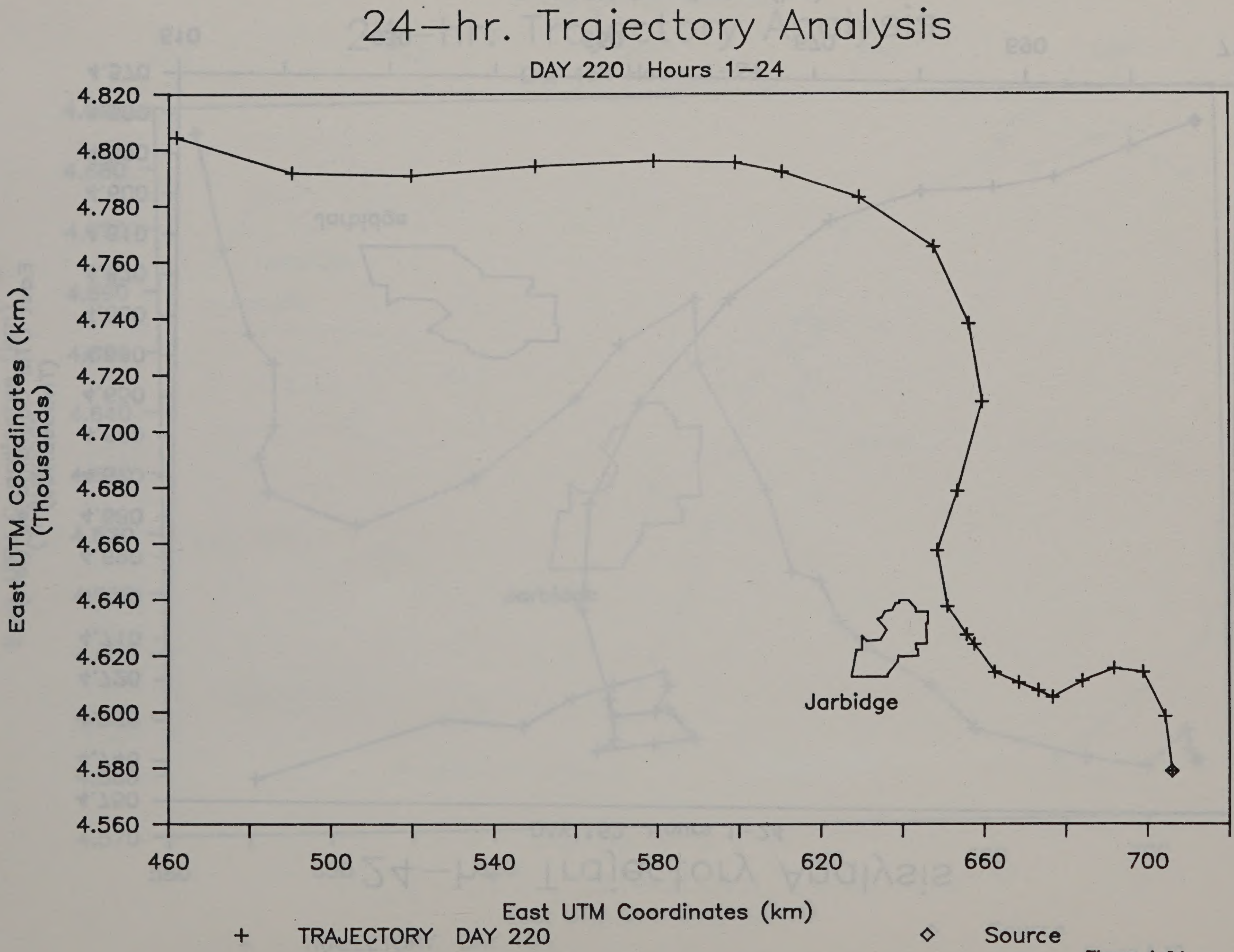

24–hr. Trajectory Analysis
DAY 220 Hours 1–24
East UTM Coordinates (km) (Thousands)
4.820
4.800
4.780
4.760
4.740
4.720
4.700
4.680
4.660
4.640
4.620
4.600
4.580
4.560
460
500
540
580
620
660
700
East UTM Coordinates (km)
Jarbidge
+ TRAJECTORY DAY 220
◇ Source

Figure A-21

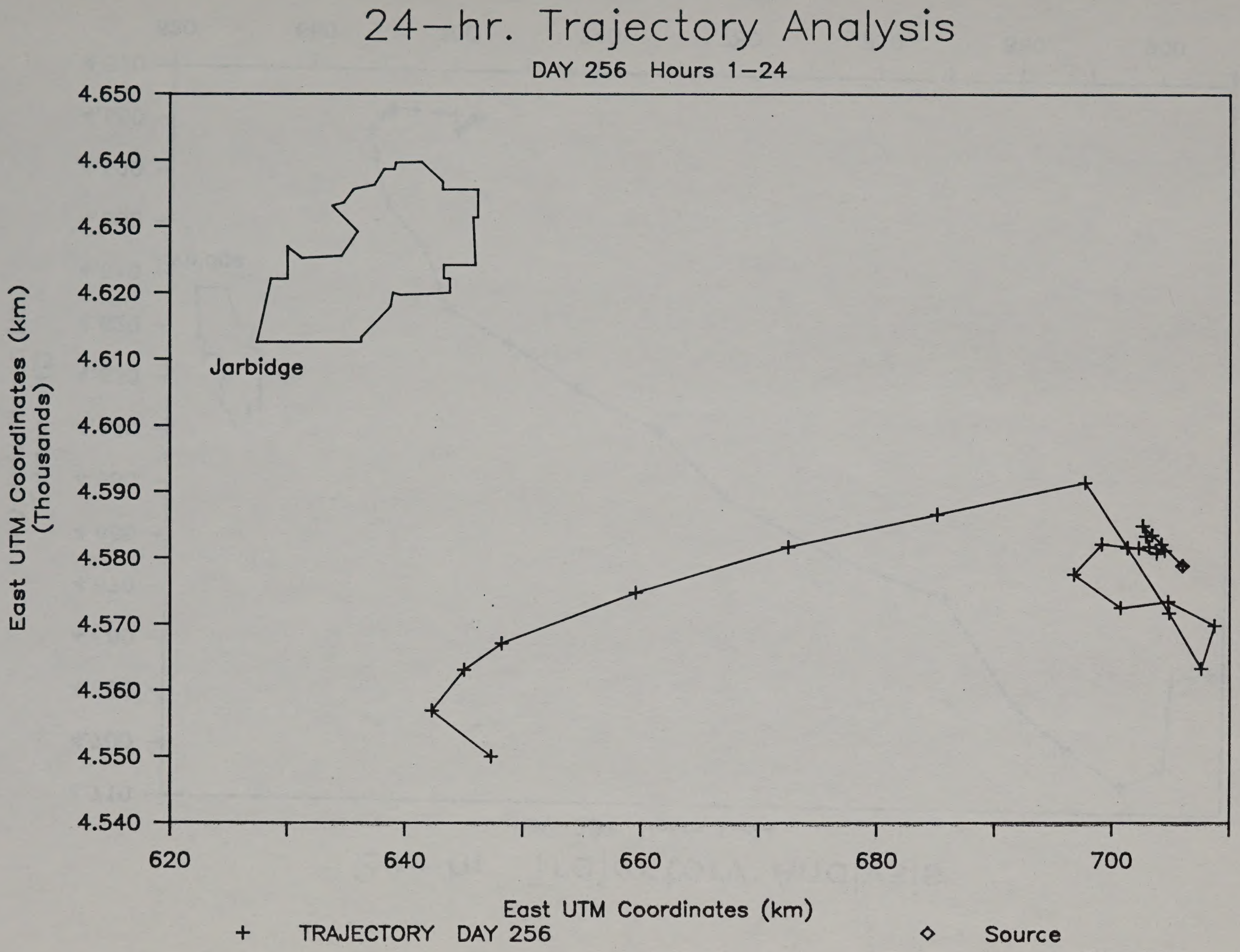

24-hr. Trajectory Analysis
DAY 256 Hours 1-24
East UTM Coordinates (km)
(Thousands)
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
4.560
4.550
4.540
Jarbidge
620
640
660
680
700
East UTM Coordinates (km)
+ TRAJECTORY DAY 256
◇ Source

Figure A-22

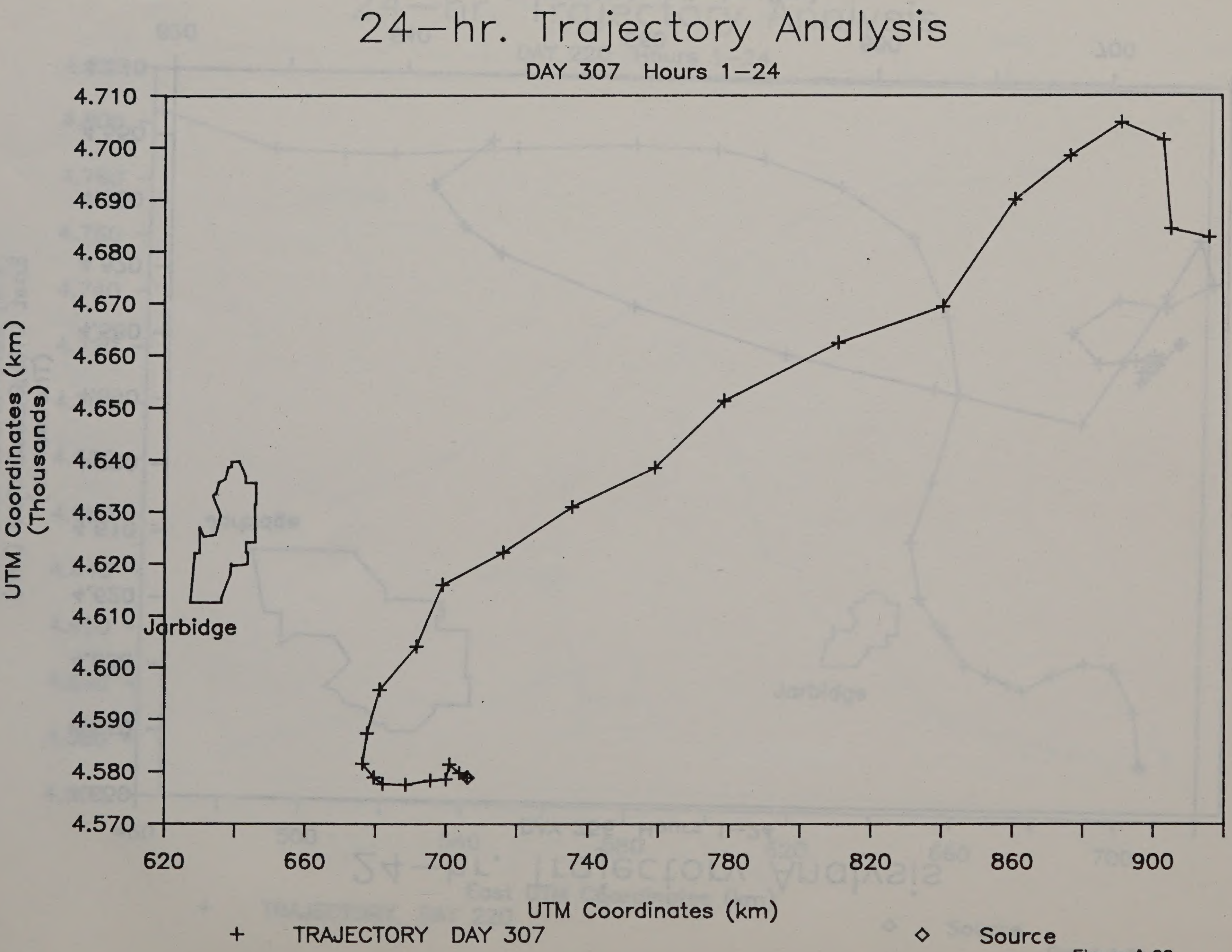

24–hr. Trajectory Analysis
DAY 307 Hours 1–24
UTM Coordinates (km) (Thousands)
4.710
4.700
4.690
4.680
4.670
4.660
4.650
4.640
4.630
4.620
4.610
4.600
4.590
4.580
4.570
Jarbidge
620
660
700
740
780
820
860
900
UTM Coordinates (km)
+ TRAJECTORY DAY 307
◇ Source

Figure A-23